Government of South Australia

Northern and Yorke Natural Resources Management Board

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Water Allocation Plan for the Clare Valley Prescribed Water Resources Area

May 2009

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Prepared by the

Northern and Yorke Natural Resources Management Board

Government of South Australia

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Natural Resources Management Act 2004

Water Allocation Plan

for the

Clare Valley Prescribed Water Resources Area

I, Jay Weatherill, Minister for Environment and Conservation, hereby adopt this Water Allocation Plan pursuant to section 80(3)(a) of the Natural Resources Management Act 2004

Hon Jay Weatherill MP
Minister for Environment and Conservation

Date: 4/5/09

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1 Introduction

1.1 Background

This document is the Water Allocation Plan for the Clare Valley Prescribed Water Resources Area (Prescribed Area), pursuant to section 76 of the *Natural Resources Management Act 2004* (the Act). This Plan replaces the Water Allocation Plan for the Clare Valley Prescribed Water Resources Area adopted by the Minister for Water Resources on 22 December 2000.

The Act requires the Northern and Yorke Natural Resources Management Board (the Board) to prepare a water allocation plan for each of the prescribed water resources in its area.

All wells and watercourses within the Prescribed Area bounded by the bold unbroken line in General Registry Office (GRO) Plan Number 368/96 were prescribed on 25 July 1996 under the provisions of the *Water Resources Act 1990*. The area bounded by the same line in GRO Plan Number 368/96 was declared a surface water prescribed area on 28 October 1999 under the provisions of the *Water Resources Act 1997* to address concerns about the ability of surface water run-off to sustain irrigation requirements while also contributing to the flow of watercourses in an amount necessary to protect the health of the watercourses and dependent ecosystems.

The purpose of the Plan is to provide criteria by which decisions about the regulation and use of water are made, that ensure that water resources are managed sustainably for current and future users and water dependent ecosystems, including downstream users and downstream water dependent ecosystems. The Plan sets out the principles for the allocation, use and transfer of water in the Prescribed Area. In addition, the Plan provides a framework for the issue of permits for the control of relevant water affecting activities. The Plan complies with the objects and requirements of the Act, assisting in the achievement of ecologically sustainable development in the region.

1.2 Clare Valley Prescribed Water Resource Area

The Prescribed Area covers an area of approximately 700 km^2 located some 100 km to the north of Adelaide (Figure 1). Approximately 5,000 people live in the Clare Valley region, with most people living in the townships of Clare, Auburn, Mintaro, Watervale, Sevenhill, Leasingham and Penwortham. Clare is the largest town, providing most of the commercial and business services in the region. The Prescribed Area is the area within the bold red line as indicated in Figure 2.

Although the name of the Prescribed Area suggests a single valley, the Prescribed Area is actually made up of numerous small catchments in what has been described as an elevated plateau. The topography of the Prescribed Area is characterised by the ridges and valleys of the northern Mount Lofty Ranges. The major watercourses of the Prescribed Area are the Hill and Hutt Rivers that drain to the north into the Broughton River and the Eyre Creek and the Wakefield River that drain to the south. The Wakefield River and Broughton River catchments are hydrologically (surface water and watercourses) and almost hydrogeologically (underground water) separate.

1.3 Description of the prescribed water resources

1.3.1 Underground water

Underground water in the Clare Valley is stored in two water-bearing aquifers: Quaternary Sedimentary Aquifers and Proterzoic Fractured Rock Aquifers present in the Adelaide Geosyncline. The aquifers of the Clare Valley predominantly occur in fissured/weathered bedrock of the Adelaide Geosyncline. Well yields and underground water salinity show large variation across the region (Figures 3 and 4). Well yields from the majority of wells are low, typically between 0.2 and 1 litre per second. Salinity of the underground water varies greatly but generally exceeds 1,000 milligrams per litre (mg/L). The lowest salinity underground water is associated with higher rainfall and higher elevations between Watervale and Sevenhill, where the salinity of underground water has been found to be well below 1,000 mg/L in many locations. To date, no significant correlation between salinity and well yield has been derived.

A fractured rock aquifer is a consolidated rock with the voids provided by cracks or fractures. The consolidated rock was formed originally from unconsolidated sedimentary material that has been subjected to heat, pressure and chemical reactions that welded the unconsolidated material together over 600 million years ago. Later deformations resulted in the formation of fractures. Underground water flows within the fractures and the majority of water is stored in the low porosity matrix. A variety of different materials including slate, shale, dolomite and quartzite form the fractured rock aquifers, and appear as geographical features such as ridges and valley floors and are extensive throughout the district. Most of the underground water resources used in the Clare Valley are extracted from fractured rock aquifers. The aquifers have a low capacity to store water due to their low percentage of pore spaces in the rock matrix. Therefore, the available resource is significantly affected by seasonal conditions. The fractured rock can be divided into two zones: a relatively permeable zone in the upper 20 – 40 metres within which fractures are closely spaced (generally < 0.5 m); and a deeper low permeability regional zone. The size and spacing of fractures tends to decrease with depth.

Sedimentary aquifers in the Clare Valley have been formed by the deposition of unconsolidated gravel, sand and silt particles through the action of rivers. Water is stored and travels through interconnected voids in these unconsolidated sediments with relatively high porosities. Sedimentary aquifers are relatively young in geological terms forming within the past 2 million years. Geographically, these aquifers form in the middle of the valley and interact closely with the surface watercourses that pass over them. The most significant alluvial aquifer occurs in the Stanley Flat area, north of Clare. Sedimentary aquifers are not extensive in the Clare Valley area and provide only a small portion of the underground water resource. These sedimentary aquifers generally have an interaction with local fractured rock aquifers.

Underground water levels are controlled by recharge to both the Quaternary and Fractured Rock Aquifer Systems. Aquifer systems have been observed to rise in response to local high rainfall recharge events and thus it is concluded that these systems are replenished annually from local precipitation. Periods of above average rainfall should result in rising underground water levels and decreasing salinity, while years of below average rainfall should result in declining underground water levels and increasing salinity. Underground water in the Prescribed Area discharges to streams, flows out of the region in aquifers and some is “lost” to evaporation where water tables are shallow, and transpiration where plant roots have access to the watertable. Water is also removed from the aquifers via pumping for use in irrigation and other activities.

Salt concentrations in the underground water of the Prescribed Area range from 200 to more than 5,000mg/L. This varies spatially, becoming more saline further away from those areas where recharge takes place and close to where underground water discharges to the surface.

1.3.2 Surface water and watercourses

The Prescribed Area straddles the catchment divide between the Broughton and Wakefield catchments and is clearly the most developed region in both of these catchments, from a water resource use and management perspective. Although the Prescribed Area covers a relatively small proportion of the Wakefield and Broughton River catchments (Figure 1), the area provides significant flows of good quality water to each river system.

The Hutt and Hill Rivers are ephemeral streams within the Prescribed Area that are major tributaries of the Broughton River. These streams flow northwards, joining the Broughton River, which continues westwards, discharging into the Spencer Gulf at Port Davis.

The Wakefield River is an ephemeral watercourse for its length, characterised by sporadic flows and long periods of no flow. The Wakefield River, its major tributary, Eyre Creek, and another notable tributary, Skillogalee Creek, flow in a predominately southerly direction within the Prescribed Area before the river flows across the coastal plain, to eventually drain into the head of Gulf St Vincent at the Port Wakefield estuary.

Rainfall in the catchment is influenced by variations in topography with the highest rainfall corresponding to areas of high elevation. Recorded rainfall records indicate that the annual average rainfall ranges from 550 millimetres (mm) at Clare (Calcannia) near the northern extent of the Prescribed Area, to 650 mm near Watervale.

Many of the watercourses of the Prescribed Area are ephemeral and many permanent pools occur in these watercourses. Skillogalee Creek is the only watercourse in the Prescribed Area that flows year round. Although significant permanent baseflow reaches and springs are found within the Prescribed Area, these systems are ephemeral, with only seasonal or episodic flows in most areas. Permanent underground water-fed pools exist along the watercourses. Some of the underground water moving through the Prescribed Area forms a baseflow to streams and this plays an important role in maintaining permanent pools during dry periods and, in the case of Skillogalee Creek, stream flows.

All of the surface water catchments have been significantly modified by land clearance, agricultural development and construction of surface water storages, which capture stream flow that would normally leave the upper parts of the major catchments.

The salt concentrations in water flowing and pooled in the Prescribed Area typically ranges from 150mg/L during wet winter months to 7,000 mg/L toward the end of summer and autumn.

Surface water in the Broughton River catchment

The Broughton River drains an area of 5,671 km^2 including two northerly-draining sub-catchments in the Prescribed Area, the Hill River and Hutt River. The Broughton River discharges to Spencer Gulf approximately 10 km south-west of Port Pirie. The median annual flow is 46,500 megalitres (ML) but varies significantly according to the rainfall in any given year.

The Hutt and Hill Rivers drain a relatively high rainfall part of the catchment and contribute significantly to stream flows in the Broughton River. Prior to 1994 the Hutt

and Hill Rivers contributed approximately 23% of the then annual flow (64,960 ML) of the Broughton River. These sub-catchments contribute relatively regular winter flow.

Hill River sub-catchment

The Hill River rises approximately 3 km east of Penwortham and flows north to the boundary of the Prescribed Area. Beyond the Prescribed Area, it joins Yakilo Creek to form the Broughton River. The Hill River drains a modified landscape that has been extensively developed for cropping and irrigated viticulture.

The Hill River sub-catchment drains an area of 230 km^2 . The River drains a relatively low-relief catchment, falling approximately 200 metres in elevation from Kadlunga to the Old Burra Road, a distance of approximately 18 km. The removal of native vegetation has promoted in-stream channelisation so that the river has cut vertical banks into the landscape. Under natural conditions, the dissipation of stream energy by vegetation and debris would likely have formed a broader, shallower stream channel than now exists. Table 1 shows the average annual rainfalls and flows as observed in the Hill River for various periods from 1969 – 2004.

Table 1. Hill River Rainfall and Observed Flows 1969 - 2004

Period	1969-84	1985-94	1995-99	2000-04
Average Annual Rainfall (mm)	571	546	556	539
Average Annual Observed Flow (ML/a)	5730	5043	2686	2568

The water table lies less than 2.5 metres below the surface near much of the Hill River within the Prescribed Area. Underground water salinity near the Hill River is interpreted to be between 1,000 and 5,000 mg/L, with the salinity of underground water generally increasing to the north. These conditions contribute to permanent, saline, underground water-fed pools along the river that sustain the perennial salt-tolerant aquatic macrophytes and provide drought refuges for aquatic fauna. Salts contributed by underground water become more concentrated in the pools in the intervals between run-off events.

Hutt River Sub-Catchment

The Hutt River rises in the vicinity of the Clare township and flows north to the boundary of the Prescribed Area. It has one significant tributary, Armagh Creek, which joins the river 5 km downstream of Clare. Beyond the Prescribed Area, it joins the Broughton River downstream of Spalding. The Hutt River drains an area of 280 km^2. Table 2 shows the average annual rainfalls and flows as observed in the Hutt River for various periods from 1969 – 2004.

Table 2. Hutt River Rainfall and Observed Flows 1969 – 2004

Period	1969-84	1985-94	1995-99	2000-04
Average Annual Rainfall (mm)	579	558	565	549
Average Annual Observed Flow (ML/a)	9768	6928	3027	2784

The water table is interpreted to lie more than 10 metres below the surface near the Hutt River and Armagh Creek in the Prescribed Area; however, the water table lies less than 2.5 metres deep just north of the Prescribed Area. Underground water salinity in the vicinity of the river is reported to be generally less than 2,000 mg/L but may exceed this concentration near the northern perimeter of the Prescribed Area.

Surface Water in the Wakefield River catchment

The Wakefield River drains an area of 690 km^2, including the southerly-draining sub-catchments in the Prescribed Area of Eyre Creek, Skillogalee Creek, Wakefield River, Pine Creek and Rices Creek. The Wakefield River discharges to Gulf St Vincent at Port Wakefield. The system has reaches with perennial flow, permanent pools and ephemeral flow. Table 3 shows the average annual rainfalls and flows as observed in the Wakefield River for various periods from 1969 – 2004.

Table 3. Wakefield River Rainfall and Observed Flows 1969 - 2004

Period	1969-84	1985-94	1995-99	2000-04
Average Annual Rainfall (mm)	588	604	659	608
Average Annual Observed Flow (ML/a)	8873	7883	6584	5310

The Wakefield River is characterised by irregular flows and long dry intermediate periods. Soil moisture levels in the catchment are typically low, so that a proportion of rainfall events is lost to seepage before run-off commences. When flows do occur, they do so as a pulse of water, rather than a slow incremental flow.

Reaches of the Wakefield River system feature underground water-driven baseflow, which maintains stream flow and permanent pools, primarily along the Wakefield River main channel and sections of the Skillogalee and Eyre Creeks throughout the drier months.

Salinity data collected at the gauging station at Rhynie between 1974 and 1983 shows variable salinity levels, reflecting the contribution of saline underground water to stream flows in the Prescribed Area. The median salinity over this period was 4,230 EC Units (2327 mg/L) with a maximum reported value of 6,450 EC units (3548 mg/L).

The Skillogalee Creek and the upper section of Eyre Creek receive the highest rainfall in the catchment. Most of the Wakefield River catchment experiences annual rainfall of less than 500 mm. The major underground water flows influencing the Wakefield River system are also provided by recharge from the Skillogalee Creek and Eyre Creek catchments. Water has been diverted for intensive agricultural activities in the adjacent Eyre Creek and Upper Wakefield River, so the Skillogalee sub-catchment now contributes the most important underground water flows to the Wakefield catchment.

1.4 Management zones

The Prescribed Area is comprised of many smaller catchments. To enable the water resources to be managed according to the nature of the resources and variations in rainfall, topography and land use, the Prescribed Area has been divided into 13 sub-regions (Figure 5). The sub-regions are largely based on sub-catchment areas, the similarity of rainfall conditions and water resource issues.

Figure 1. Location of Clare Valley Prescribed Water Resources Area

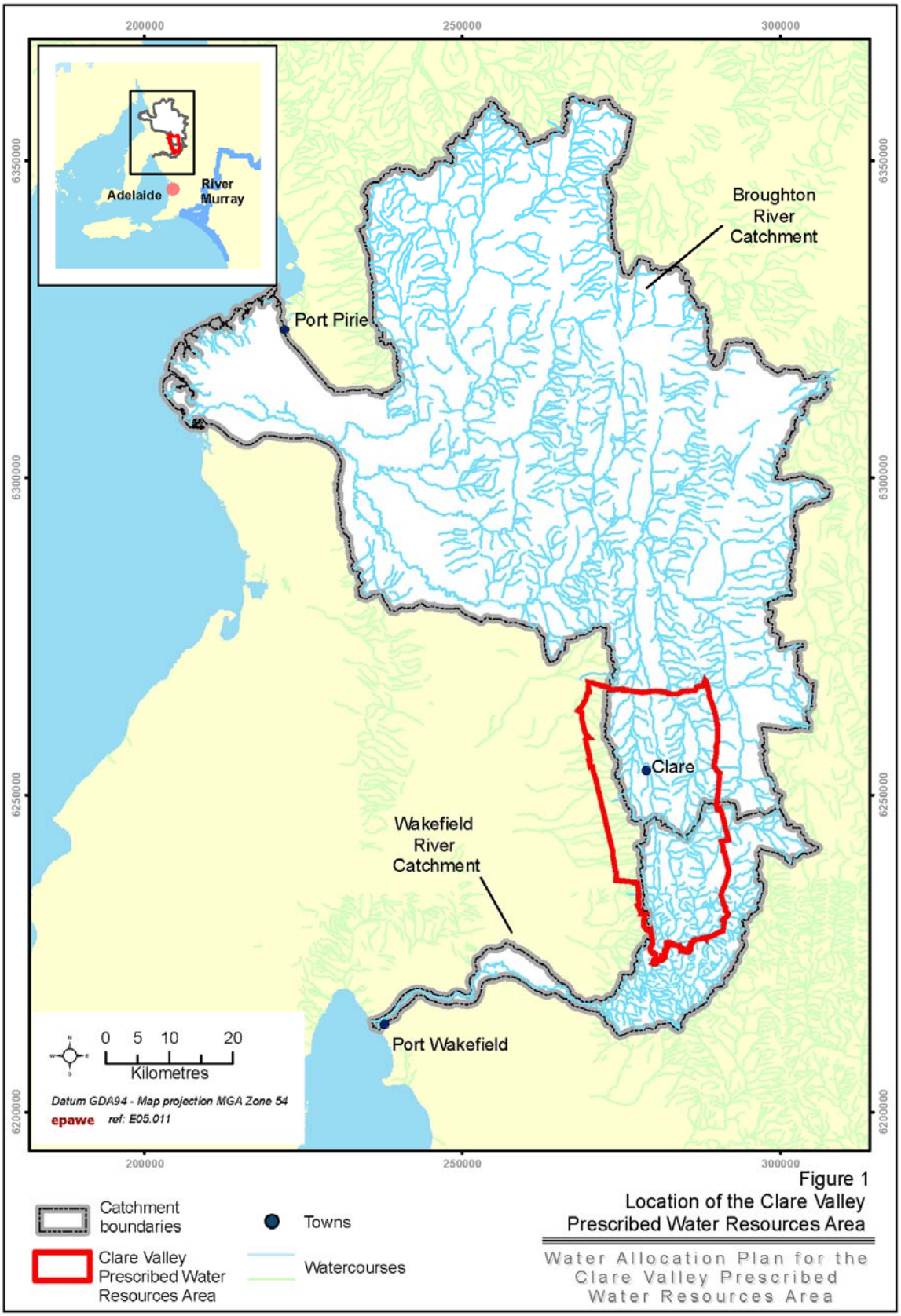


Figure 2. The Clare Valley Prescribed Water Resources Area

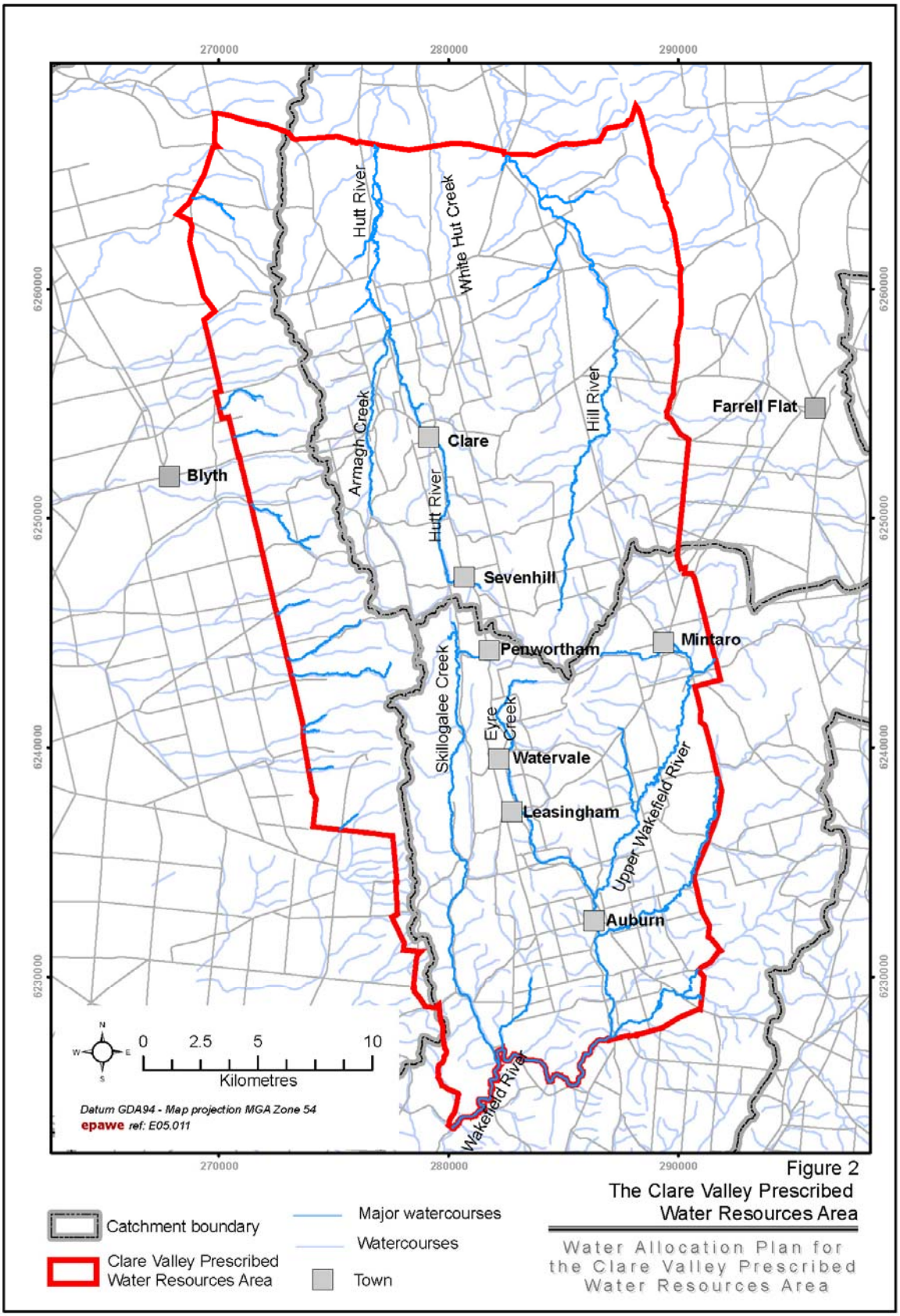


Figure 3. Yields of wells in the Prescribed Area

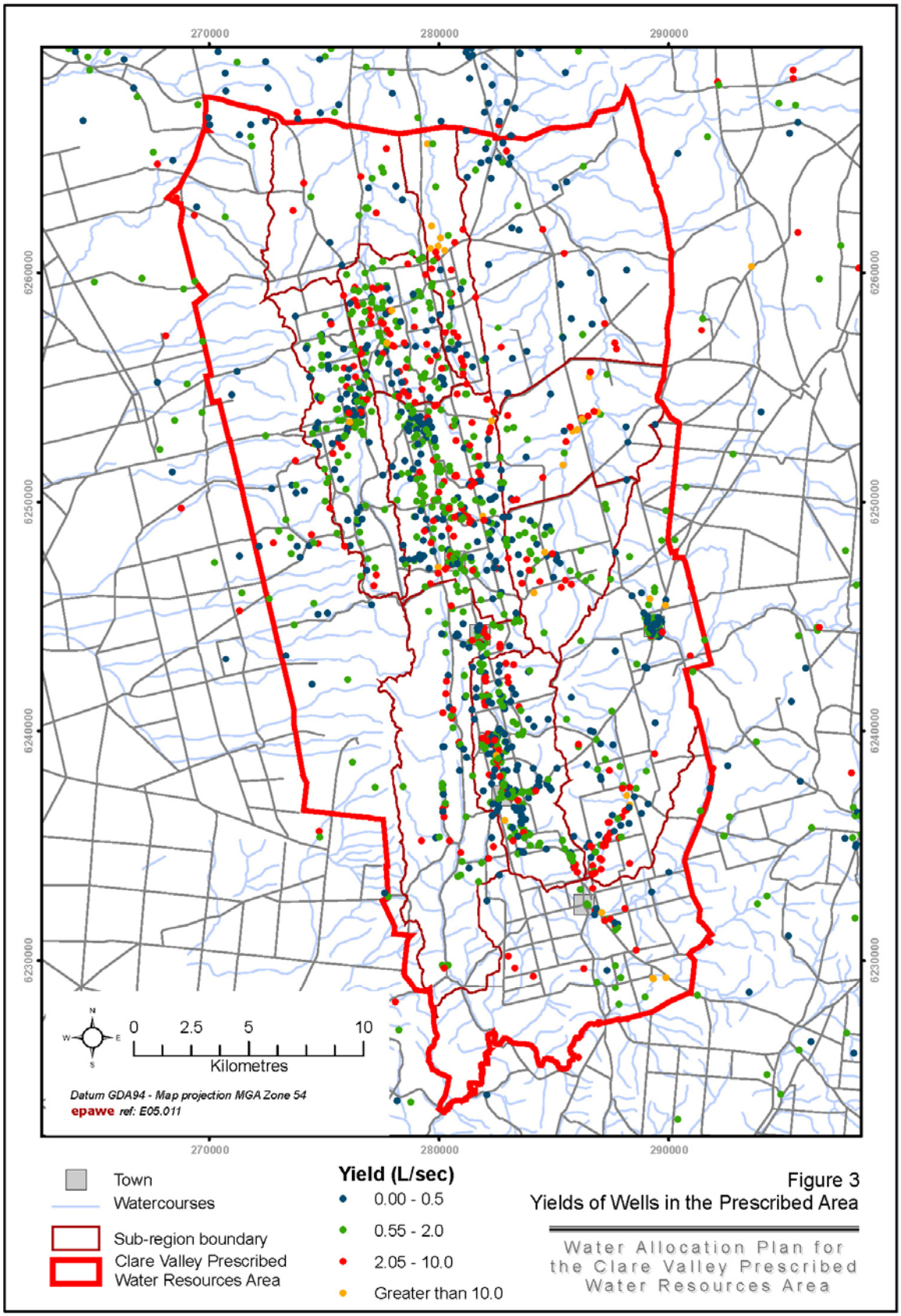


Figure 4. Salinity of wells in the Prescribed Area

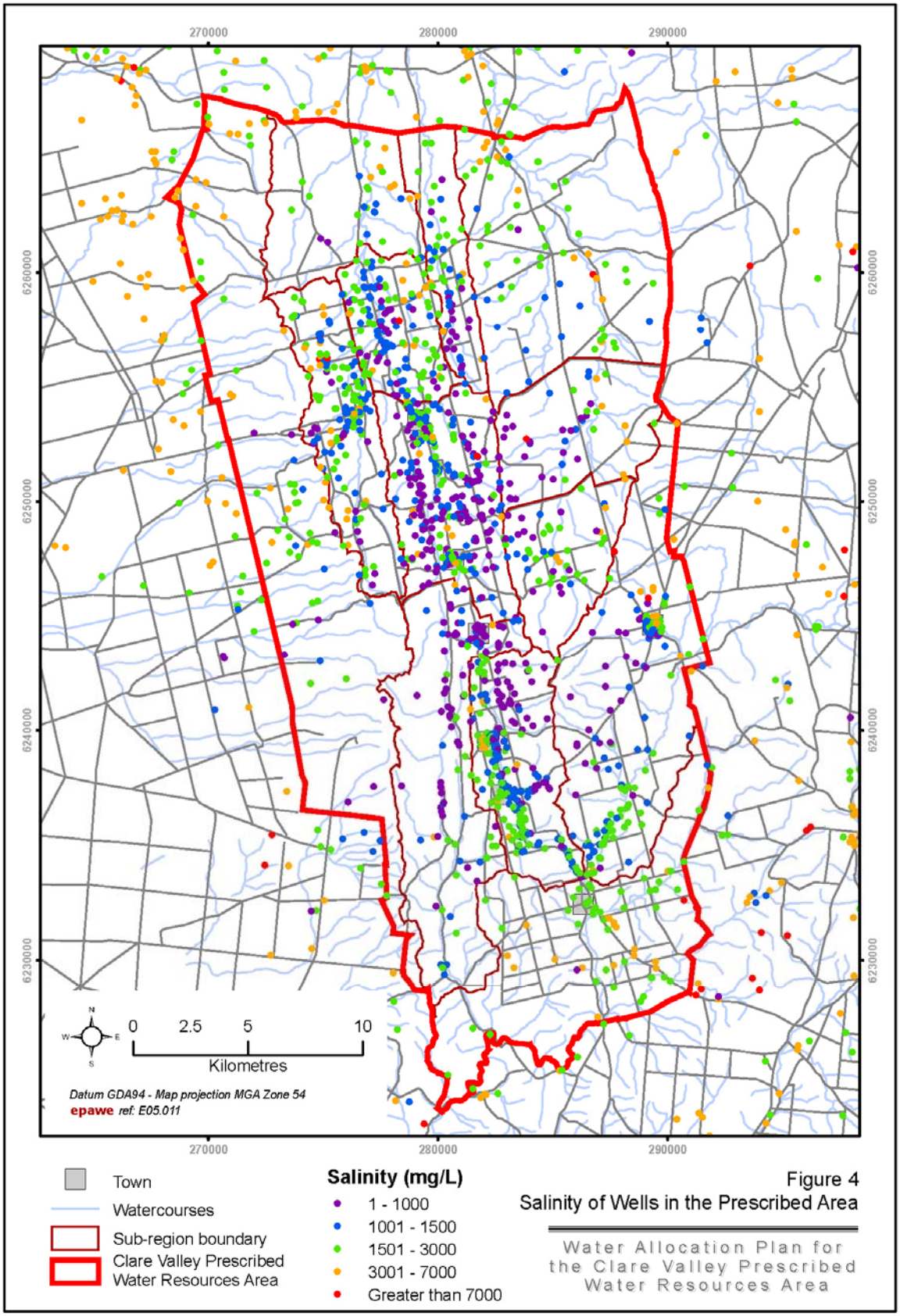
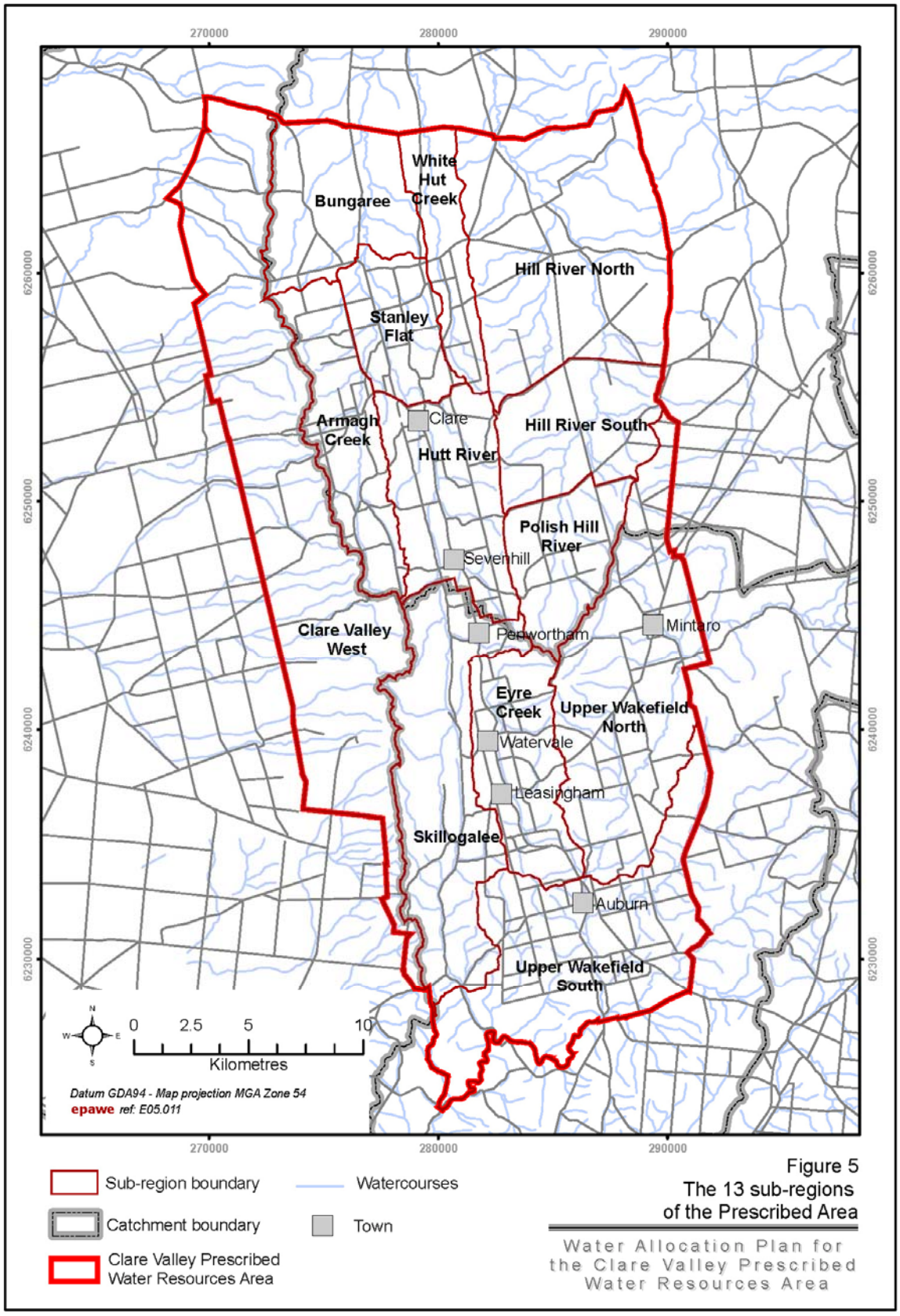


Figure 5. The 13 sub-regions in the Prescribed Area



2 Water dependent ecosystems and environmental water requirements

The primary studies of the water dependent ecosystems and environmental water requirements of the region that have been undertaken since the previous Water Allocation Plan was published in 2000 are:

- Favier, D., Scholz, G., VanLaarhoven, J. and Bradley, J. (2004). *A River Management Plan for the Broughton Catchment.* Report 2004/16, Department of Water, Land and Biodiversity Conservation, South Australia.
- Favier, D., Rixon, S. and Scholz, G. (2000). *A River Management Plan for the Wakefield Catchment.* Department for Environment and Heritage, South Australia.

Further assessments of water dependent ecosystems undertaken to guide the development of policies for the importation of water into the region were documented in Resource and Environmental Management (2002). *Environmental Assessment of the Clare Valley Water Supply Scheme Proposal*. Report prepared by Resource and Environmental Management Pty Ltd for the South Australian Water Corporation, Adelaide.

The following assessment of the water dependent ecosystems and environmental water requirements of the Prescribed Area was based primarily on information contained in these reports. While the study methods and outcomes of these reports are not contradictory, differences in the approach of each of these studies has resulted in varied presentations of the results in the coming sections.

2.1 Water dependent ecosystems and environmental water requirements of the Broughton River catchment

2.1.1 Hill River sub-catchment

There is little remnant riparian vegetation along Hill River and crops have been established to the top of the channel bank in some areas. Riparian vegetation is generally dominated by exotic grasses or crops. A significant area of sedgeland vegetation is associated with a small stand of *Muehlenbeckia florulenta* (tangled lignum). There are some small stretches of sedgeland and *Eucalyptus* species over-storey along the upper reaches, just within the boundary of the Prescribed Area.

The in-stream vegetation is highly modified and dominated by dense beds of *Phragmites australis (*common reed) and *Typha domingensis* (cumbungi).

Despite modifications to stream geomorphology and vegetation, a diverse assemblage of aquatic macroinvertebrates was reported from a sampling site at the gauging station downstream of the Prescribed Area (located half-way between Hilltown and Andrews). According to the Ausrivas stream health methodology, the macroinvertebrate assemblage was in very good or “reference” condition. This means that the diversity and abundance of taxa in the assemblage closely matches assemblages from undisturbed streams of a similar habitat type. The quality of the macroinvertebrate assemblage is likely to reflect persistent flow, which is largely derived from underground water, and the availability of dense in-stream vegetation.

This macroinvertebrate data indicates the importance of underground water discharge to stream health and the importance of intact riparian vegetation. Despite the loss of riparian vegetation from much of the catchment upstream, a diverse macroinvertebrate assemblage was reported because of quality of habitat at that locality.

No fish survey data has been collected from the Hill River but it can be expected that the River would support the same species reported from similar catchments nearby, particularly *Galaxias olidus* (mountain galaxias) and *Psuedogobius olorum* (blue spot goby).

2.1.2 Hutt River sub-catchment

The Hutt River has a low grade, falling approximately 10 metres in elevation over 6 km from Clare to Stanley Flat. The upper part of the river, near Clare, has an intermittently flowing channel. The riparian vegetation is typically a low woodland dominated by *Eucalyptus leucoxylon* (South Australian blue gum), *E. camaldulensis* (river red gum) and *E. odorata* (peppermint box). The understorey is dominated by exotic species including *Foeniculum vulgare* (fennel), *Rosa rubiginosa* (briar rose)*, Lycium ferocissimum* (African boxthorn) and *Cytisus scoparius* (English broom). The channel is incised with steep banks and little diversity in in-stream physical habitat.

Downstream of Clare, the river forms a narrow channel incised into a broad floodplain. The riparian vegetation is dominated by exotic grasses or crops, although some small patches of sea rush (*Juncus kraussii*) occur. In-stream vegetation is dominated by common reed (*Phragmites australis)* and cumbungi (*Typha domingensis)*. Permanent pools occur in the river between reed beds near the northern boundary of the Prescribed Area, where the water table is shallow.

Fish have been surveyed in the Hutt River at the road bridge 8 km south of Spalding. The only native species reported was *Galaxius olidus*, which was greatly outnumbered by non-native fish species, such as *Gambusia holbrookii* (mosquito fish) and *Perca fluviatilis* (redfin perch).

Macroinvertebrate sampling at the same site reported a diverse aquatic macroinvertebrate community considered to be in “reference” condition according to the Ausrivas methodology. This area is supported by persistent baseflow derived from underground water discharge to permanent pools and by run-off events in the Clare area upstream. One unexpected species of macroinvertebrate was collected at this site. *Lingora aurata* (the caddisfly) is usually collected from cool flowing streams with gravel or sandy beds. It has been recorded from numerous sites in the southern Mount Lofty Ranges, on Kangaroo Island and in the south east of South Australia. This is the most northerly observation of this species. The protection of this community may be important to maintain the genetic diversity in this species; however, there is no other information on which to base conservation recommendations.

This data indicates the importance of preserving remnants of good-quality stream habitat even in otherwise degraded catchments. These sites are likely to be important sources of fauna when habitat is favourable elsewhere in the river, such as during small to low flow events known as freshets.

2.1.3 Downstream water-dependent ecosystems

Flow generated in the Prescribed Area from rainfall and underground water contributes to the water requirements of ecosystems downstream.

Between the Prescribed Area and the Broughton River, the Hutt and Hill Rivers both feature significant reaches with permanent pools. These pools are maintained by discharge from a shallow, saline underground water table that is maintained in part by

underground water recharge in the Clare area. The salinity of the pools is limited by regular run-off events generated from the relatively high rainfall area upstream. In both the Hutt and Hill Rivers, diverse macroinvertebrate communities have been found and are attributed to the persistence of baseflow and flushing events.

The Broughton River downstream of the Hutt River as far as Cockeys Crossing has permanent baseflow, which contributes to the habitat requirements of aquatic macroinvertebrates and fish. Reaches with permanent baseflow support populations of a bristle worm, which is endemic to the catchment, including the Broughton River at Frome Crossing, Redhill, Cockeys Crossing and south of Spalding. Macroinvertebrate assemblages indicate that the Broughton River is in a healthy condition in comparison to other river systems in South Australia. Sites with high macroinvertebrate diversity occur in the Broughton River downstream of the Hutt and Hill River at Frome Crossing and Red Hill, both of which have permanent baseflow. Surface run-off is also important to macroinvertebrate diversity. The number and diversity of animals at most sites were higher in wetter years and higher in spring, reflecting higher flows, compared to autumn when flow was lower.

The importance of persistent or permanent flow in downstream reaches is indicated by a number of plant and animal communities. *Lingora aurata* was only collected from sites with permanent or semi-permanent flowing water: the Broughton River at Redhill and Hutt River south of Spalding. Dense stands of submerged or emergent aquatic plants occurred on Broughton River at Redhill and Frome Crossing, and supported a species of moth (family *Pyralidae*) which feeds on submerged aquatic plants that require permanent inundation or persistent seasonal flooding. Deep permanent pools and overhanging vegetation provide habitat for *Paratya australiensis* (freshwater shrimp).

Seasonal flows are important for maintaining fish habitat, for providing spawning or migration cues, for recruitment and to allow movement within the system. Reaches of the Broughton River with permanent flow support two native fish species *Pseudogobius olorum* and *Galaxias olidus*.

The Broughton River catchment supports six native frog species. All are widespread across South Australia with the exception of *Pseudophryne bibroni* (Bibron's Toadlet). Frogs favour slow-moving or static water. They depend on water to breed and to provide habitat for the small aquatic and flying insects on which they feed.

The Broughton River downstream of the Prescribed Area supports riverine forests, woodlands and shrublands and riparian and in-stream sedge communities. Flows that inundate the banks or floodplain are important to maintain the growth and health of these plants.

The Prescribed Area is one of the highest rainfall areas of the Broughton River catchment. Therefore the management of the Hill River and Hutt River sub-catchments significantly influences habitat of water dependent ecosystems downstream.

2.1.4 Water requirements

Approach

The water requirements of the Broughton River were evaluated by Favier, Scholz, VanLaarhoven and Bradley in 2004 and the water requirements presented here are drawn from that report.

Flow requirements were defined to fulfil specific physical and ecological roles in the streams. These roles were identified by reviewing the significance of particular flow bands in stream geomorphology and the growth, reproduction, dispersal and survival of aquatic biota. Flow bands represent flow events with similar discharges and durations that can be related to specific ecological functions.

Flow Bands

The flow bands of the Broughton River are defined as follows:

- **Underground water and permanent baseflow:**
  Underground water tables intersecting the streambed are important to maintain permanent pools and baseflow in the catchment. Baseflow maintains stream flow over summer. Variability in baseflow is typical of a natural flow regime. The levels will rise as evaporation decreases and soil moisture increases during late autumn-winter.
- **Low flows / seasonal baseflow:**
  Low flows typically provide a minimum flow to cover the bed of the channel for long periods. Low flow events are a direct response to rainfall but are related to a seasonal rise in baseflow that peaks over the winter months. This seasonal rise may be important for the breeding and recruitment of frogs and macroinvertebrates, transport of nutrients and organic matter, and fish development and recruitment.
- **Mid flows:**
  Mid flows are generated primarily by rainfall run-off and typically have flow heights around 50-75% of reed height. These flows are important for fish breeding and migration and for maintaining riparian vegetation.
- **High to bankfull flows:**
  High to bankfull flows typically inundate approximately 50-100% of the stream channel. Bankfull flows are of particular importance in maintaining watercourse channels, sustaining riparian processes and fish breeding.
- **Overbank and catastrophic flows:**
  Overbank flows are important for floodplain and geomorphic functions. Catastrophic flows, i.e. large, infrequent flood events, cause significant streambed and channel rearrangement and reset the in-stream and floodplain habitats.

Environmental flow requirements

To fulfil the required ecological and geomorphic roles, events in each flow band must occur with a specific discharge, frequency and duration. Flows are specified on the basis of three types of water requirements. *Optimum flows* are expected to maximise or increase populations. *Sustaining flows* maintain species in the long term. *Minimum (or survival) flows* may enable short-term survival but if applied over longer time periods will result in species decline.

Flow requirements are presented for the Hill River and upper Hutt River where flow is directly influenced by the management of water resources in the Prescribed Area (Table 4 and Table 5). The roles of flow bands in the lower Hutt River (Table 6) and the Broughton River downstream of the Hill River confluence (Table 7) are also presented. As they drain an area of the Broughton catchment with relatively high rainfall, the Hutt and Hill Rivers contribute significantly to flow and must be managed to account for environmental water requirements downstream.

2.2 Water dependent ecosystems and environmental water requirements of the Wakefield River catchment

Water requirements of the Wakefield River catchment were evaluated by Favier, Rixon, and Scholz in 2000. The river system was divided into distinct geomorphologic or process zones. Each zone possesses unique physical and hydrological characteristics, which distinguish it from other parts of the river system and determines the ecological

components. Information collected on the biophysical attributes of each zone was used to gain an understanding of the habitat types and ecological processes and hence environmental water requirements of each zone. For each zone, important flow levels and their associated functions are identified.

The following seven zones were identified:

- **Lower meandering zone:**
  Wakefield River main channel from the town of Balaklava to the estuary;
- **Upper meandering zone:**
  Wakefield River main channel from downstream of The Rocks to Balaklava;
- **Mobile zone:**
  approximately 2 km downstream of Hermitage Creek to 1 km downstream of The Rocks;
- **Transition zone***:*
  upstream of Robin's Ford to the confluence with Skillogalee Creek;
- **Constrained zone:**
  Skillogalee Creek;
- **Incised zone:**
  Wakefield River main channel from Skillogalee Creek to Wookie Creek and Eyre, Pine, Rices, Hermitage and Woolshed Flat Creeks; and
- **Chain of ponds zone:**
  Wakefield River main channel upstream of Wookie Creek. This Zone is upstream of the Prescribed Area and is not considered in this Plan.

Table 4. Flow requirements of the Hill River

Key flow bands	Lateral extent / height and description	Key functions	Frequency (no. of events: years) (range and sustaining)	Duration (range and sustaining)	Seasonality
Underground water table	River bed wetted and pools filled	▪ maintain macrophytes, pools and aquatic habitat	Permanent	Permanent	Permanent (in summer it is critical to maintain water level in pools)
Seasonal low flow	River bed wetted and pools maintained above underground water table (surface flows plus seasonal increase in baseflow)	▪ maintain aquatic habitat, macrophytes and water quality ▪ habitat connections ▪ developing and recruiting fish	Annual	Seasonal flows in winter-spring (low flow needs to occur on average for a 2 to 4 week minimum)	Late winter-spring. Pulse in flows.
Mid flow	About 50-75% of reed height and inundating benches	▪ trigger for fish breeding ▪ maintain water quality ▪ migration of fish and macroinvertebrates	Range 1:1 to 1:5 Sustaining 1:3	Range 2-10 days Sustaining 4 days	Late winter – spring
High flow (bankfull)	Bankfull	▪ maintain water quality ▪ migration of fish and macroinvertebrates ▪ channel maintenance ▪ sediment transport	Range 1:1 to 1:5 Sustaining 1:3	Range 2-4 days Sustaining 2 days	Late winter – spring
Overbank flow	Inundating at least remnant riparian sedgeland plus some floodplain	▪ inundation of floodplain and sedgeland (riparian zone) ▪ transport of organic matter ▪ increase habitat area ▪ channel maintenance ▪ sediment transport	Range 1:3 to 1:6 Sustaining 1:3	Range 1-2 days Sustaining 1 day	Late winter – spring
Catastrophic flow	>1992 flood	▪ scouring of pools ▪ habitat resetting flow ▪ sediment transport	Large floods > 20 year recurrence interval	-	-

Table 5. Flow requirements of the upper Hutt River from the confluence of Armagh Creek to the confluence of the Broughton River

Key flow bands	Lateral extent / height and description	Key functions	Frequency (no. of events: years) (range and sustaining)	Duration (range and sustaining)	Seasonality
Underground water table	River bed wetted and pools filled	▪ maintain macrophytes, pools and aquatic habitat	Permanent	Permanent	Permanent (in summer it is critical to maintain water level in pools)
Seasonal low flow	River bed wetted and pools maintained above underground water table (surface flows plus seasonal increase in baseflow)	▪ fish development and recruitment ▪ maintain aquatic habitat, water quality, pools and macrophytes ▪ habitat connections	Annual	Seasonal flows in winter-spring (low flow needs to occur on average for a 2 to 4 week minimum)	Late winter-spring. Pulse in flows.
Mid flow	About 50% of reed height and inundating benches	▪ maintain water quality ▪ trigger for fish breeding ▪ local migration of fish ▪ migration of macroinvertebrates	Range 1:1 to 1:5 Sustaining 1:3	Range 2-10 days Sustaining 4 days	Late winter – spring
High flow (bankfull)	Bankfull	▪ maintain water quality ▪ migration of fish and macroinvertebrates ▪ channel maintenance ▪ sediment transport	Range 1:1 to 1:5 Sustaining 1:3	Range 2-4 days Sustaining 2 days	Late winter – spring
Overbank flow	Inundating some floodplain	▪ floodplain and riparian zone inundation ▪ transport of organic matter ▪ increase habitat area ▪ channel maintenance ▪ sediment transport	Range 1:3 to 1:7 Sustaining 1:5 to 1:6	Range 1-5 days Sustaining 1 day	Late winter – spring
Catastrophic flow	>1992 flood	▪ scouring of pools ▪ habitat resetting flow ▪ sediment transport	Large floods > 20 year recurrence interval	-	-

Table 6. Flow requirements of the lower Hutt River from the road bridge 8 km south of Spalding to the Broughton River confluence

Key flow Bands	Lateral extent / height and Description	Key functions	Frequency (no. of events: years) (range and sustaining)	Duration (range and sustaining)	Seasonality
Underground water table	River bed wetted and pools filled	▪ maintain macrophytes, pools and aquatic habitat	Permanent	Permanent	Permanent (in summer it is critical to maintain water level in pools)
Baseflow / seasonal low flow	Low flow across stream bed (with seasonal increase in winter)	▪ fish development and recruitment ▪ maintain aquatic habitat and water quality ▪ habitat connections	Annual	Almost continuous flow (seasonal flow increase needs to occur for minimum of 2 to 4 weeks)	Late winter-spring. Pulse in flows.
Mid flow	About 50% of reed height	▪ trigger for fish breeding ▪ increase habitat area (in reeds) ▪ maintain water quality ▪ migration of macroinvertebrates and fish (e.g. galaxiids) ▪ transport organic matter	Range 1:1 to 1:5 Sustaining 1:3	Range 2-10 days Sustaining 4 days	Late winter – spring
Bankfull flow	Bankfull flow	▪ recruitment and establishment of riparian vegetation ▪ local fish migration ▪ maintain sedgelands ▪ migration of macroinvertebrates ▪ increase habitat area ▪ transport sediment and organic matter ▪ channel maintenance	Range 1:1 to 1:5 Sustaining 1:3	Range 2-4 days Sustaining 2 days	Late winter – spring
Overbank flow	Flood waters extend into floodplain	▪ floodplain and riparian zone inundation ▪ transport of organic matter ▪ increase habitat area ▪ channel maintenance ▪ sediment transport	Range 1:3 to 1:7 Sustaining 1:3 to 1:6	Range 1-5 days Sustaining 1 day	Late winter – spring
Catastrophic flow	>1992 flood	▪ scouring of pools ▪ habitat resetting flow	Large floods > 20 year recurrence interval	-	-

Table 7. Flow Requirements of the Broughton River between the Hill River Confluence and Yacka

Key flow bands	Lateral extent / height and description	Key functions	Frequency (no. of events: years) (range and sustaining)	Duration (range and sustaining)	Seasonality
Underground water table	River bed wetted and pools filled	▪ maintain permanent pools ▪ provide soil moisture to maintain sedgelands and macrophytes	Permanent	Permanent	Permanent
Baseflow (permanent)	Covers much of riverbed with water in most pools	▪ maintain macrophyte beds, ▪ aquatic habitat, pools and maintain water quality	Permanent	Permanent	Permanent
Baseflow / seasonal low flow	Covers riverbed to inundate lowest benches and most pools and riffles	▪ maintain water quality ▪ increase habitat area (for macroinvertebrates and macrophytes) ▪ fish development and recruitment ▪ inundate bench to increase habitat area	Discharge exceeds 0.6 m^3/sec for 15 to 20 days each year	Median duration 70 days per year Range of 0 to 200 days	A pulse on top of permanent baseflow during winter-spring
Mid flow	About 50% of reed height	▪ trigger for fish breeding ▪ local migration of fish (e.g. galaxids) ▪ increase habitat area (among reeds) ▪ migration of macroinvertebrates ▪ maintain aquatic habitat and water quality	Range 1:1 to 1:5 Sustaining 1:3	Range 2-10 days Sustaining 4 days	Late winter – spring
Overbank flow	Inundating the floodplain to 30 to 50 cm	▪ increase habitat area (depending on duration) related to floodplain inundation ▪ recruitment and establishment of riparian and floodplain vegetation (lignum and grasses) ▪ channel maintenance flow ▪ sediment transport ▪ removal of fines from riffles	Range 1:3 to 1:7 Sustaining 1:5 to 1:6	Range 2 to 20 days Sustaining 2 days	Late winter – spring
Catastrophic flow	>1992 flood	▪ recruitment and establishment of floodplain vegetation (lignum, Broughton Willow) ▪ scouring of pools ▪ floodplain processes (e.g. erosion, sedimentation, avulsion) ▪ major habitat resetting flow ▪ channel maintenance	Large floods $\geq$ 20 year recurrence interval	Exceeds 2 days	Winter – spring

2.2.1 Skillogalee Creek

The flow path of Skillogalee Creek is influenced by north-south trending strike valleys associated with outcropping bedrock ridges in the Clare area. The Creek is constrained within a narrow valley floor with steep sides. Bedrock outcrops in the stream bed create large pools upstream. The stream retains a largely natural geomorphology. It has been classified as the **"constrained zone"**.

The sub-catchment drains a relatively high rainfall area where annual rainfall exceeds 600 mm. Underground water discharges to the stream and generates permanent flow and maintains permanent pools. Underground water salinity is interpreted to be less than 2,000 mg/L and to lie less than 2.5 metres below the surface.

The stream has a relatively steep bed grade and generates high energy flows. The streambed elevation falls approximately 170 metres from Hoyleton Road to the confluence with the Wakefield River, over a distance of 14 km.

The stream supports a fragmented overstorey of *Eucalyptus camaldulensis* but has little remnant native understorey vegetation. There are exceptional sites with diverse understorey vegetation, for example, downstream of the Port Road where native in-stream and overstorey vegetation provides important riparian habitat.

Skillogalee Creek has the highest level of macroinvertebrate species richness of all the assessed sites in the Wakefield catchment. A number of uncommon macroinvertebrates were reported (e.g. *Tascorema* species., *Koornunga inconspicua*, *Apsilochorema* species) from the mayfly and caddisfly groups, which were not found in other areas of the Wakefield system. This may be due to the higher incidence of cool flowing water and a greater degree of steam shading than at other surveyed sites. It may also reflect the relatively high discharge generated in this sub-catchment by higher rainfall and less saline underground water discharge.

A survey failed to find any fish in Skillogalee Creek. No ecological reason for their absence has been proposed.

2.2.2 Pine and Rices Creeks

Pine Creek and Rices Creek are ephemeral streams with some small permanent saline pools. Pine Creek, which lies at the southern boundary of the Prescribed Area, drains an area where underground water is interpreted to lie less than 10 m below the surface and to have salinities in excess of 5,000 mg/L. Rices Creek drains the area to the east of Auburn where underground water lies less than 2.5 m below the surface and underground water salinity is 2,000 to 5,000 mg/L. The creeks are dry for most of the year and only flow after periods of heavy rain. The pools may provide important refuges for aquatic fauna during summer. The watercourses are deeply incised into the landscape with a gully-like appearance and have little in-stream structural diversity and steep banks.

These creeks have been classified in the **"incised zone"** of the catchment.

The riparian vegetation in these creeks is highly degraded. The creeks are accessed by stock and infested by weeds. Native riparian vegetation is limited to small areas of *Eucalyptus camaldulensis, E. leucoxylon* and *E. odorata* with an exotic understorey. In-stream vegetation is generally absent.

2.2.3 Eyre Creek

Eyre Creek rises in the foothills of Mount Horrocks and flows in a southerly direction through the town of Watervale to join the main channel of the Wakefield River just north of Auburn. Eyre Creek is an ephemeral stream with a number of small underground

water dependent permanent pools. Underground water in the vicinity of the creek is interpreted to be less than 2,000 mg/L and lies less than 5 m below the surface.

Eyre Creek has been classified as having an **"incised zone"** geomorphology.

Eyre Creek has undergone significant change from its natural state. The stream channel has been eroded and has a box shaped appearance with little in-stream physical diversity. The riparian zone has little native vegetation and is dominated by exotic species, particularly *Fraxinus rotundifolia* (desert ash). Scattered *Eucalyptus camaldulensis* are present and *Phragmites australis* and *Typha domingensis* are present in the stream channel.

A survey of fish failed to find any fish in the Creek at the site sampled at Watervale.

2.2.4 Wakefield River from Wookie Creek to Skillogalee Creek

The Wakefield River rises to the east of the Prescribed Area. It drains an area to the east of Mintaro and flows across a relatively low relief plain before joining Eyre Creek in the Clare Hills near Auburn. Underground water near the river is interpreted to lie less than 2.5 m below the surface and to have a salinity of less than 2,000 mg/L.

This reach of the Wakefield River has an **"incised zone"** geomorphology. Typically, the channel is heavily eroded with a box shaped appearance, little in-stream vegetation and steep banks. Riparian vegetation is degraded and dominated by exotic grasses and a very sparse overstorey of native or exotic trees. In areas dominated by exotic vegetation the riparian zone provides poor quality habitat for aquatic fauna.

A survey of fish fauna found only one species, the exotic *Gambusia holbrookii,* at a site at Auburn.

2.2.5 Wakefield River from the Skillogalee Creek confluence to the boundary of the Prescribed Area

The reach of the Wakefield River from Skillogalee Creek to the boundary of the Prescribed Area is characterised by a series of small floodplains set into remnant high level terraces. The River is controlled by the valley; however, there are some floodplain formations present. Features of this zone are high bed slopes and high energy flows that have resulted in heavy erosion of in-stream structures. The in-channel environment is variable and has areas dominated by cobble and gravel-sized sediments and others dominated by fine silt. The sediments have been stabilised by dense reed beds.

Underground water salinity near the river is reported to be between 2,000 and 5,000 mg/L. The water table is interpreted to lie less than 5 m below the surface.

This reach has been classified with a **"transition zone"** geomorphology.

Some good pool-riffle habitats exist but there are also substantial amount of degraded and incised channel habitat filled with reeds. Dense stands of *Phragmites australis* and *Typha domingensis* occur along the edge of the channel. They provide good stream stabilisation but only limited habitat quality and diversity.

Permanent pools in this zone provide refuges for aquatic fauna. A survey found abundant exotic fish (*Gambusia holbrookii* and *Salmo trutta* (brown trout) but only one native species (*Pseudogobius olorum*). The deep pools and riffles provide very little habitat complexity for native fish. Riffles are shallow, often stony areas in streams that have a rapid turbulent flow, and are important habitat for certain species of fish and macroinvertebrates. The absence of riffles limits the diversity of macroinvertebrate habitat.

2.2.6 Wakefield River downstream water-dependent ecosystems

The Prescribed Area contributes a significant proportion of the flow in the Wakefield River. The highest rainfall areas in the catchment lie at the heads of Skillogalee Creek and Eyre Creek. Underground water discharge in the area also contributes significantly to baseflow downstream.

A site of particular ecological value is located at The Rocks. This is within a reach of the Wakefield River featuring a network of permanent and semi-permanent pools. It is the only site in the catchment upstream of the estuary where native fish were observed (*Pseudogobius olorum*). It supports a diverse invertebrate community because there are permanent spring-fed pool-riffle sequences. The area was also rated relatively healthy according to the Ausrivas methodology because it supported macroinvertebrate taxa sensitive to disturbance. The Rocks supports diverse aquatic vegetation, including charophytes *Potamogeton pectinaus* (pondweed), *Phragmites australis* and *Typha domingensis,* and relatively intact riparian vegetation.

The ecological values of The Rocks partly depend on local underground water discharge. However, freshets from upstream are also important in scouring pools and for providing migration opportunities for native fish and macroinvertebrates. Seasonal flows also temporarily increase the area of habitat available to aquatic fauna and riparian vegetation, allowing stream biota to grow and reproduce.

The reach of the Wakefield River from 1 km downstream of the Rocks to 2 km downstream of Hermitage Creek is classified as the **"mobile zone".**

A second site of ecological significance exists on the floodplain of the lower Wakefield River. The floodplain supports swamps of *Muehlenbeckia florulenta* and *Melaleuca* spp. and salt marsh vegetation. Local underground water discharge in this region contributes to the salinity and soil moisture environment which is important to these waterlogging-tolerant and salt-tolerant species. Flood flows generated upstream will also promote the growth and recruitment of floodplain vegetation and will provide habitat opportunities for aquatic fauna and waterbirds. This reach was classified as the **"lower meandering zone".**

A third noteworthy feature is the riparian vegetation on the Wakefield River between The Rocks and Whitwarta. The vegetation comprises an open woodland of *Eucalyptus camaldulensis*. Winter stream flows contribute to the water requirements of the vegetation and flood flows that inundate the banks support recruitment events for riparian plant species. This zone is classified as the **"upper meandering zone".**

2.2.7 Wakefield River catchment water requirements

Approach

The water requirements of the Wakefield River catchment were evaluated in 2000. In each geomorphic zone, the roles of flow in ecosystem function and diversity were assessed. Six flow bands were identified (Table 8). The flow bands represent flow events with similar discharges and durations that can be related to specific ecological functions.

Table 8. Roles of flow bands in geomorphic zones

Flow band	Roles of flow bands in geomorphic zone		
	Constrained zone	**Incised zone**	**Transition zone**
Baseflow	▪ supports potential hyporheic environments ▪ maintains permanent pools ▪ health of riparian vegetation	▪ maintains riffle flows ▪ maintains permanent pools ▪ maintains riparian and in-stream vegetation	▪ maintains permanent pools ▪ maintains health of riparian vegetation ▪ maintain expected hyporheic environments
Freshets	▪ maintain water quality in pools	▪ maintains water quality	▪ maintains water quality of permanent pools
Habitat connection flows	▪ riffle flows between pools ▪ riparian vegetation growth ▪ habitat diversity	▪ flow of water between pools ▪ maintain water quality in permanent pools ▪ wet channel margin and riparian vegetation ▪ transport of fine sediment	▪ riffle flows between pools ▪ aquatic fauna migration ▪ maintain water quality ▪ water riparian vegetation
Mid flows	▪ connect pool and riffle habitats ▪ scour algae and move fine sediment ▪ mobilise organic matter	▪ transport of coarse sediment ▪ connections between habitats ▪ fish movement ▪ organic matter pulses	▪ major connecting flows between pool and riffle habitats ▪ fish migration between freshwater and marine habitats ▪ mobilise organic matter
Bankfull flows	▪ reset habitat ▪ scour pools ▪ move large pulses of organic matter ▪ water riparian vegetation		▪ water riparian zone ▪ fish migration ▪ mobilise bed material ▪ maintain channel
Floodplain flows		▪ reset channel structure ▪ wet riparian zone and floodplain	▪ inundate floodplain and water red gums ▪ maintain channel morphology

Table 8 presents the roles attributed to the flow bands in the three geomorphic zones present in the Prescribed Area. Three of the zones, Constrained, Incised and Transition, occur in the Prescribed Area and the provision of flow to achieve these outcomes is directly related to the management of water resources in this area. Three zones, Lower Meandering, Upper Meandering and Mobile, occur downstream of the Prescribed Area. Watercourses in the Prescribed Area contribute to flow in these reaches and must be managed to account for their environmental water requirements.

The flow bands are defined as follows.

- **Baseflow:**
  Baseflow is dependent on underground water flow, which maintains the stream flow throughout the driest months. Most of this flow enters the Wakefield River directly upstream of the junction of Skillogalee Creek with a magnitude related to rainfall in the previous season. While reasonably constant, baseflow does vary throughout the year, peaking in winter, as a consequence of seasonal variations in soil moisture and aquifer discharge. The river is an ephemeral system that depends heavily on baseflows (especially in the summer months) to maintain pool water levels and quality.
- **Freshets:**
  Freshets are small to low flow events. At the top of the catchment these are small surface water pulses caused by rainfall events. These flows are important for flushing and maintaining water in permanent pools. In the lower part of the catchment, freshet flows occur on the recession of higher flood events or are masked by the rise in baseflow over winter.
- **Habitat connection flows:**
  Habitat connection flows provide the minimum flow to cover the bed of the channel over a reasonable duration of time over the whole length of the Wakefield River. Flows in the order of 0.5 to 1 m^3/sec flowing over a 4 day period are required 2 to 3 times a year to enable fish movement between pools. These flows are the large persistent flows that occur throughout the wetter months of the year and extend downstream to reach the estuary. These flows are particularly important for fish and macroinvertebrate movement between The Rocks and the confluence of Wakefield River and Eyre Creek. Most importantly these flows maintain the riparian vegetation along the saline areas of the lower Wakefield River, but they are also in the Mobile Zone and Upper Meandering Zone for the hyporheic environments (the area below the streambed surface that is permanently saturated).
- **Migration flows:**
  Primarily, migration flows allow migratory fish to complete their life cycles through movement between the river and the estuary. Migratory fish recruitment is dependent on flows in autumn/early winter (March, April and May) for reproduction and spring (September) for migration. Flows that exceed 3 m^3/sec over a minimum 4 day period are required to enable fish to move between the estuary and the pools within The Rocks area. These flows are required at least once in autumn/early winter and again in late spring at least every 3 years because of the 3 to 4 year average life span of these fish.
- **Mid flows:**
  Mid flows maintain in-stream structures such as benches, bars and pool-riffle sequences. Mean daily flows of 6 to 10 m^3/sec are required at least once every 2 years to maintain the in-stream morphology.
- **High flows:**
  High flows inundate approximately 50 to 100% of the stream channel at various sites and maintain and enhance channel complexity. Mean daily flows of 15 to 25 m^3/sec are required approximately once every 6 years.

- **Floodplain flows:**
  Modify the channel and habitat structure. Mean daily flows of 40 to 70 m^3/sec are required with an average frequency once every 20 or more years. In the 25 years of recorded flow events, a greater than 70 m^3/sec discharge has occurred only once.

Environmental water requirements

To fulfil the required ecological and geomorphic roles, events in each flow band must occur with a specific discharge, frequency and duration. These have been defined for a single location in the catchment, namely Gauging Station AW506500, the Wakefield River Gauge near Rhynie (Table 9). It is assumed that by meeting the target flow conditions at this point, the flow requirements of reaches upstream and downstream will be met.

Table 9. Environmental Water Requirements of the Wakefield River.

Flow band	Peak flow (m^3/sec)	Duration flow (daily max m^3/sec)	Average frequency	Median event duration	Importance
Baseflow	-	current level	current	current	protect at current levels
Freshets	<0.5	current levels	weekly	1 day	less important in winter, more important in spring
Habitat connection	1-3	<1	3 times/ year	4 days	habitat connection and migration between pools/habitat maintenance in winter and spring
Migration flows	6-10	~3	at least once/ year	7 days	fish reproduction/ migration flows in spring and autumn
Mid flows	15-25	6-10	once every 2 years	-	reset flows/habitat reset
High flows	40	15-25	once every 6 years	-	reset flows/habitat reset
Floodplain	70	40	once every 20+ years	-	reset flows/habitat reset

2.3 Phreatophytes

Phreatophytes are plants that access underground water as part of their water requirements. Phreatophytes may occur in the riparian zone of watercourses, where underground water is shallow. In this Plan, riparian phreatophytes are considered part of the stream ecosystem. Phreatophytes may also occur on flats or plains where underground water is shallow, at sites distant from drainage lines.

There is no direct evidence of underground water use by vegetation outside watercourses in the Prescribed Area. Underground water dependence can be interpreted by the presence of deep rooted trees in areas of shallow underground water. Underground water is interpreted to be less than 2 m deep below the flats to the east of the Clare Hills, particularly in the catchment of the Wakefield River downstream of Mintaro and the upper Hill River catchment. The flats are vegetated with grassy

woodlands of *Eucalyptus leucoxylon* with substantial remnants of native grasslands, *Allocasuarina verticillata* (drooping sheoak) and *Callitris gracilis* (southern cypress pine). Underground water salinity is interpreted to be less than 2,000 mg/L in this area. It is possible that deep rooted vegetation, particularly *Eucalyptus camaldulensis* and *E. leucoxylon* trees, access underground water and are vulnerable to changing underground water conditions.

2.3.1 Water requirements of phreatophytes

It is not possible to quantify what the water requirements of phreatophytes in the Prescribed Area may be. There is a lack of the information required to quantify water requirements, specifically information on the nature and distribution of shallow underground water and on the use of underground water by vegetation.

In general, it is reasonable to expect that the water requirements of phreatophytes will be protected by maintaining current underground water depths and salinities in areas of remnant vegetation where the water table is less than 5 m deep.

This broad statement can only be made more specific by collecting data, such as:

- the depth and salinity of underground water below significant vegetation remnants; and
- the use of underground water by vegetation in these areas.

2.4 Water Dependent Fauna

The key fauna components of the ecosystems are frogs, fish and macroinvertebrates.

2.4.1 Frogs

Frog species found in the Wakefield and Broughton catchments include: *Limnodynastes dunerillii* (eastern banjo frog), *Neobatrachus pictus* (painted frog), *Crinia signifera* (common froglet), *Limnodynastes tasmaniensis* (marbled frog), *Litoria ewingi* (brown tree frog) and *Pseudophryne bibronii* (bibron's toadlet). Frogs will generally form part of the riparian and in-stream ecosystems. During periods of high flows and particularly floodplain flows, major breeding events and feeding can take place on the floodplain, for example in the lignum swamps.

Flow requirements

Underground water and baseflow are important for frogs as well as freshets/habitat connection flows to ensure their habitat and food source areas are inundated and to maintain a minimum water quality and water level. Migration/midflows are required for frog breeding once every 2-3 years, which should last 1-3 weeks. Floodplain and high flows will trigger utilisation of the floodplain habitats.

Fish

The in stream zone, with its pools, riffles and runs, is important for fish. The estuary and coastal wetlands also form an important habitat. During long duration high flow/floodplain flow events fish will also breed and feed in floodplain swamps. Fish species occurring in the Broughton and Wakefield catchment are presented in Table 10.

Table 10. Fish Observed in the Broughton and Wakefield Catchments

Zone	Species
Estuarine and Marine	*Mugil cephalus* (sea mullet) *Aldrichetta forsteri* (yellow-eyed mullet) *Atherinosoma microstoma* (small mouth hardyhead)
Freshwater/Estuarine (Move between freshwater and estuary)	*Pseduogobius olorum* (bluespot goby) *Pseudaphritis urvillii* congolli
Freshwater only	*Galaxias olidus* (mountain galaxias) *Tandanus tandanus* (tandanus catfish) *Macculochella peeli* (Murray cod) (native, introduced) *Macquaria amigua* (callop) (native, introduced)
Exotics	*Perca fluviatilis* (redfin perch) *Carassius auratus* (goldfish) *Gambusia holbrooki* (plague minnow) *Salmo trutta* (trout) *Cyprinus carpio* (European carp)

Flow Requirements

Fish require both underground water and baseflow to maintain permanent pools. They also require a migration/mid flow or even high flow to allow for fish migration between the marine and freshwater systems. Mid flow to floodplain flows are required to enable fish breeding and migration to sea. The frequency of the mid flow to floodplain flows required depends on the lifespan of the fish species, but generally ranges from every year to once every 5 years.

2.4.2 Macroinvertebrates

More than 240 macroinvertebrate species have been found in the catchments. Some taxa are significant when considering biodiversity and conservation issues in the catchments because of their restricted or unusual distribution, for example, a bristle worm (*Polychaeta*) species, endemic to the Broughton, *Lingora aurata* (caddis fly), *Diaprepocoris barycephala* (the water boatman) and a moth of the family *Pyralidae*. The in-stream zone, particularly permanent pools and the hyporheic zone (the area below the streambed surface that is permanently saturated) are important habitats for macroinvertebrates, as well as estuaries and coastal wetlands. Macroinvertebrates will also utilise the floodplain during high flow/floodplain flow events.

Flow requirements

Macroinvertebrates require underground water and baseflow to maintain permanent pools, flow over riffles, a wet channel bed and reedbed habitats. The hyporheic zone requires underground water/baseflow to maintain the saturated zone and habitat connection flows/high flows to maintain activity in the zone.

Freshets and habitat connection flows are important for maintenance of water quality, flow over riffles and connections between pools. Mid flow – floodplain flows are important for large recruitment events for macroinvertebrates.

2.5 Water quality

Although riparian and in-stream flora and fauna species may have varying degrees of tolerance to aspects of water quality, the general requirements of water quality to maintain the water dependent ecosystems and their biota are:

- low salinity;
- low algal count;
- minimal fluctuations in water temperature;
- low levels of pollutants, such as sewage and faecal matter, agricultural chemicals and nutrients;
- low turbidity; and
- high levels of oxygen.

Analysis of flow-weighted salinity along the Hutt and Hill Rivers does not show a clear trend. Higher salinities tend to be linked to drought periods, indicating that salinity and flow are linked. Many quality aspects are linked to the flow regimes but separate management will be required to prevent an increase of pollutants, which do not necessarily depend on flow regimes but more on land use adjacent to the watercourses.

Riparian vegetation is an important factor in water quality, as it can act as a buffer for sediments, pollutants and nutrients.

3 Effects on other water resources

The taking of surface water, underground water and water from watercourses in the Prescribed Area has detrimental effects on water resources downstream of the Prescribed Area. The needs of the ecosystems that use water from the Broughton and Wakefield River systems downstream from the Prescribed Area have been described in Section 2.

There are further demands for the water resources of the Broughton and Wakefield catchments downstream from the Prescribed Area, including stock watering, and tourism and recreational activities such as fishing and swimming which rely on the aesthetic value of the water resources. In the lower Broughton, water is also used for some irrigation of crops and pasture. Permanent pools are the main source for all of these uses. There is also some use of floodplain flows in lower Broughton reaches for flood irrigation.

Maintaining low to mid flows that freshen the water in the pools is essential for stock watering and irrigation uses. Long dry periods with no surface flows can cause significant rises in the salinity of these pools, making them less suitable for stock use or irrigation. Similar low to mid flows will also ensure that the water quality and quantity is maintained for aesthetic values.

The policy objectives and principles set out in this Plan are designed, in part, to limit the detrimental effects of the use of the water resources on downstream water systems. Consequently, it is expected that the policy objectives and principles in this Plan will not adversely affect downstream water resources.

4 Capacity of the resource to meet demands

4.1 Demands

The future water source requirements in the Prescribed Area based on current activity are unlikely to change substantially when averaged over the long term. However, there will be short-term fluctuations when more or less water is required, largely linked with variations in climate. Allocations of water may be insufficient for the needs of many licensed users in times of drought, meaning that access to water from other sources will be required. During these drought times, it is likely that the amount of water available would be limited and many licence holders will not be able to access their full entitlement.

4.1.1 Ecosystems

As outlined previously in Section 2, the ecosystems in the Prescribed Area and in the areas of the Broughton and Wakefield catchments downstream of the Prescribed Area have considerable requirements for water in terms of various flowbands, frequencies and duration of flows.

4.1.2 Use of water for stock watering and domestic purposes

Other than the townships, there is limited reticulated water supply available throughout the Prescribed Area. This supply is confined to properties adjacent to SA Water pipelines. Water, including that for domestic purposes and stock watering, must be obtained from the local underground water, surface water resources or watercourses.

Based on average stocking rates in the Prescribed Area and the total area of the Prescribed Area, the demand for water for watering stock is estimated to be approximately 750-1,000 ML per year. Domestic demand outside towns and settlements is approximately 350 ML per year.

The capacity of dams that supply water for domestic use and for watering stock other than intensively farmed stock is approximately 2,400 ML, which clearly exceeds the estimated demand for stock and domestic water. In addition, underground water is used in many cases for domestic use and for watering stock. The large dam capacity for domestic use and for watering stock is the result of dams often being oversized, for reasons of security against seepage and evaporation. Due to the relatively large size of these dams and lack of covering to prevent evaporation, they experience large evaporation losses. There is no information available about the volumes of underground water extracted for stock and domestic use. The use of water for stock is expected to remain relatively stable. Domestic use may increase as a result of further subdivisions.

4.1.3 Town Water Supplies

Water supply is not only needed for permanent residents but also for the tourism industry, which is often focussed in the settlements. The main source for town water supplies is currently reticulated supply from the River Murray. Clare and Auburn have had reticulated water supply for some years. Following the commissioning of the SA Water Clare Valley Water Supply Scheme, which was completed in September 2004 and officially opened in December 2004, the Clare Valley townships of Watervale, Penwortham, Mintaro, Sevenhill and Leasingham have been provided with a reticulated water supply for the first time. Armagh remains the only township in the Clare Valley dependent on local water for the town water supplies.

The Clare Valley Water Supply Scheme has a design capacity of 7,300 ML per year, bringing filtered water from the River Murray for the purpose of municipal water supply and irrigation of high value crops, including wine grapes. This imported water is relatively expensive to purchase, so it is expected that the local water resources will be used wherever this is possible. The impact of the use of this water on the receiving prescribed water resources and on the productive capacity of the land must continue to be reviewed throughout the Prescribed Area.

It is estimated that 150 ML per year of underground water is needed to supplement this reticulated supply. This demand for underground water in the townships is expected to remain relatively stable, although some growth can be expected if the tourism industry develops further.

4.1.4 Irrigation

The most widely irrigated crop in the Prescribed Area is wine grapes. There are approximately 5,400 hectares of grapevines in the Clare Valley, which has increased from 2,000 hectares in 1995 and 4,200 hectares in 1999. Compared to most other grapevine growing regions in South Australia, Clare Valley vineyards apply on average a lower rate of water for irrigation. Not all vines in the Clare Valley are irrigated and the vineyards that are irrigated generally follow deficit irrigation practices.

The quantity of all water allocations in 2005 was approximately 5,300 ML, representing an increase of approximately 26% on the 4,200 ML allocated in 1999. In 2005, approximately 2,250 ML of surface water and water from watercourses and 3,050 ML of underground water was allocated (or the equivalent in hectares and maximum irrigation rates). This compares with approximately 1,500 ML of surface water and water from watercourses and 2,700 ML of underground water allocated (or the equivalent in hectares and maximum irrigation rates) in 1999.

The total capacity of dams for licensed purposes in 2004 was estimated at 3,997 ML. Dam capacity exceeds the allocation of surface water and water from watercourses, because dams have historically been oversized for reasons of security and because of this they experience large evaporation losses. Table 11 provides the total estimated capacity of licensed dams and the number of dams in each sub-region. The dam capacity in certain sub-regions is high due to some very large flood-pumping dams, particularly in Eyre Creek. Figure 6 shows the distribution of dams in the Prescribed Area including licensed and unlicensed dams.

Actual volumes being used are determined from meter readings. Where water is managed in complex configurations between storages, adjustments are made to minimise the chance of the water use being metered twice, e.g. once to measure how much water is diverted to a dam and once to measure how much is taken out of a dam. The estimated average licensed water use for the 5 year period, including the years

2000 to 2004, from watercourses and surface water was 1,200 ML. The estimated annual average total licensed water use from underground water in that period was 1,650 ML.

There remains some interest in further expansion of irrigation in the Prescribed Area, subject to availability of water and/or further water efficiency increases.

Table 11. Dam numbers and capacities by sub-region

Name of major river catchment	Name of sub-region	Number of dams	Number of licensed dams	Volume of licensed dams (ML)	Volume of dam develop-ment (ML)
Wakefield River	Eyre Creek	78	21	600	695
	Skillogalee	108	21	242	350
	Upper Wakefield North	132	13	462	629
	Upper Wakefield South	93	4	54	211
Total Wakefield River catchment		*411*	*59*	*1,358*	*1,885*
Hutt River	Hutt River	214	33	492	805
	Stanley Flat	103	24	300	414
	Armagh Creek	215	52	333	623
	White Hut Creek	42	6	246	327
	Bungaree	95	2	14	175
Total Hutt River catchment		*669*	*117*	*1385*	*2,344*
Hill River	Polish Hill River	108	14	794	982
	Hill River South	108	4	397	688
	Hill River North	44	2	59	451
Total Hill River catchment		*260*	*20*	*1,250*	*2,121*
	Clare Valley West	95	1	4	101
Total Prescribed Area		**1435**	**197**	**3,997**	**6,451**

4.1.5 Commercial

In addition to allocations for irrigation, water has also been allocated to winery use, aquaculture and a feed lot. Water use for commercial purposes is negligible at this point in time, relative to the amount used for irrigation. While it is likely that the demand for water by the commercial sector will increase, any future growth will only be possible subject to the availability of water allocated under this Plan or the availability of reticulated municipal or imported water in appropriate areas.

4.2 Capacity of surface water and watercourses

Although the surface water and watercourses in the Prescribed Area are ephemeral, they supply a significant amount of water. The total capacity of all dams, including for domestic use and for watering stock, in the Prescribed Area at the time of publication is estimated to be approximately 6,450 megalitres. Because the region can experience extended periods of below average rainfall, the capacity of surface water and watercourses will vary with time.

Run-off from the Hill and Hutt Rivers has been recorded since 1969 and the Wakefield River since 1941. The average actual annual flow measured at the three flow recording sites on the Hill, Hutt and Wakefield Rivers in the period 2000 to 2004 was 10,660 ML. Analysis of the recordings show that flows are highly variable from year to year but would have averaged about 25,000 ML per year in the pre-irrigation era. In the median year, the flow would have been only about one half of this. About 20% of these flows would be generated outside the Prescribed Area. Furthermore, the recorded flows contain baseflow contributions which are unique to their downstream locations and which are not observed in the higher sub-catchments of the Prescribed Area.

In 1995, subsidiary flow gauges were sited on the Eyre Creek at Watervale and Auburn and on the Hutt River at the Clare Caravan Park. In 2003, flow recording commenced at a site on Skillogalee Creek at Goodonga. These confirm the generally disproportionately higher run-off in the higher rainfall areas but also suggest a high spatial variability in run-off due to local characteristics. For example, analyses indicate that annual run-off depths (for equal annual rainfall depths) for the total Wakefield River catchment are generally only approximately one half of those of the total Hutt River catchment, with the Hill River catchment lying between these.

The rainfall in the Clare Valley is higher than in the surrounding plains and provides good quality water to the Broughton and Wakefield Rivers. However, over-development of surface water and watercourses has detrimentally impacted on the quality and quantity of the water to sustain the needs of the environment and downstream users.

Under the Act, watercourse water and surface water are considered separately. In the Prescribed Area it is difficult to distinguish between the contribution of run-off to the surface water resources and to water in watercourses and in most cases, the management of these resources are combined. Similarly, it is difficult to know the volume of water that is discharged from the underground water and contributes to the baseflow in watercourses or the permanent pools. Therefore, the capacity of the surface water and watercourses at this stage is based on the mean annual run-off and the area of land within each sub-region. Investigations show that some sub-regions, such as Eyre Creek, have reached or exceeded their maximum sustainable limit for dam development.

Analysis shows that the flows are reducing in accordance with the history of irrigation development, measured diversions and estimated losses. The proportionate impacts are greater in low rainfall years than higher rainfall years.

The availability of surface water in the Prescribed Area is likely to further reduce under predictions of climate change. It will also depend on changes to land use and stock and farm practices. For example, if improved practices such as stubble retention or contour banking hold just one extra millimetre per hectare of water that currently runs off, this would be the equivalent of reducing the flow observed at the three downstream gauges by nearly 1,000 ML per year.

4.3 Capacity of the underground water resource

Recharge to underground water occurs regionally throughout the Prescribed Area and occurs when the soil moisture increases to such levels that the water infiltrates into the ground. In some cases, underground water recharge can occur directly where the fractured rock is exposed, commonly on slopes and ridgelines. When this infiltration reaches the underground water it is referred to as underground water recharge. Some recharge, particularly to alluvial aquifers, occurs through the bed of watercourses, known as “losing” streams.

The amount of recharge is dependent on the duration of the flow and the connection of the watercourse with the aquifer. Where underground water is discharged into a watercourse, this is defined as baseflow, known as “gaining” streams.

Due to the nature of the fractured rock aquifers, the volume of good quality underground water is unknown and it is difficult to predict the long-term sustainability of the underground water resource. Primary Industries and Resources SA began an extensive monitoring program in the Clare Valley in 1987/88 to monitor the depth and salinity of the underground water. The results to date indicate that:

- large draw-downs in water table levels during the summer are recorded but these have been shown to recover during an above average rainfall season. Water levels can vary by up to 5 metres seasonally with the shallowest depth to the water table recorded generally in October/November and the deepest recorded usually in April/May; and
- a number of wells show a large seasonal variation in salinity. When water levels drop, some wells show an increase in salinity.

Based on the best available information from data, it had previously been estimated that the average annual underground water recharge is no greater than 0.3 ML/ha (30mm). However, it is now considered that there is great variability in the recharge rates at different sites across the district and it is not considered that 0.3ML/ha of underground water is available to be extracted from all areas of the Clare Valley and it is considered that in many areas it is lower than this.

An assessment of underground water levels and salinity trends in comparison with underground water extraction and rainfall data undertaken by the Department of Water, Land and Biodiversity Conservation in 2006 found that in most management zones, the underground water level and salinity displayed a stable to slightly decreasing trends. The assessment found that in the majority of the management zones throughout the Prescribed Area the underground water resource is sufficient to provide for current extraction rates, which are lower than previous rates of allocation in these regions. It is not considered that the use in these zones could sustain an increase in use to the previous allocated volumes.

It was found that the present allocation in management zones Armagh Creek, Eyre Creek, Hill River South, Hutt River, Polish Hill River, Upper Wakefield North and White Hut Creek, should be maintained or reduced to ensure that underground water systems do not become more stressed. There is some opportunity for increased allocation from the Clare Valley West management zone if demand for underground water exists in this zone; however, it is considered that the underground water quality and bore yields in this region may limit further development.

4.4 Capacity of imported water

Imported water, brought in via SA Water's Clare Valley Water Supply Scheme, provides additional capacity in the Prescribed Area. The amount of water and the locations where it will be used depend on the effect of the use of imported water on the receiving prescribed water resources and the productive capacity of the land. The principles and policies that have been adopted for the allocation of imported water in the Prescribed Area provide the practical guidelines for the allocation of imported water by means of permits and water licences.

As mentioned earlier, the Scheme has a design capacity of 7,300 ML per year, bringing filtered water from the River Murray for the purpose of municipal water supply and irrigation of high value crops, including wine grapes. To date permits have been issued to for access to 2000 ML of water from this scheme. The Clare Valley townships of Watervale, Penwortham, Mintaro, Sevenhill and Leasingham have been provided with a reticulated water supply for the first time. Imported water is relatively expensive, so it is expected that the local water resources will be used wherever this is possible.

4.5 Capacity of all water resources to meet demands

Since European settlement, the Prescribed Area has been modified by native vegetation clearance, development of land for farming and local and regional drainage. These changes have resulted in more frequent flows, with larger peaks and shorter duration in watercourses of the region. Conversely, investigations show that revegetation and land management changes in the last 20 years have caused a reduction in run-off rates in the Prescribed Area. Farm dams constructed in the Prescribed Area to capture the surface water run-off for irrigation, stock, domestic and recreational use have further interrupted the flow rates in the catchments.

Diversions from watercourses have the potential to reduce the frequency, magnitude and duration of stream flow and hence the health of water dependent ecosystems. Farm dam development and over-extraction of underground water that feeds the baseflow in the surface water has the potential to significantly reduce the low flow component of the stream flow of the watercourses.

The capacity of the water resources of the Prescribed Area to meet demands on a continuing basis will depend on several factors that vary for each management area. They include the rate and timing of extractions from the watercourses and aquifers, which is influenced by the development of water harvesting infrastructure. Further to this, the watercourses of the Prescribed Area are ephemeral by nature and are characterised by highly variable frequency, duration and magnitude of flows. As a result of this variation, the capacity of the resource to meet demand will vary according to the season and resultant stream flow.

Given the level of infrastructure development, the nature and size of the resources and the requirements for ecosystems and downstream users the prescribed water resources have no capacity for any increases in extraction above current levels. There are localised problems, with demand approaching and/or exceeding the capacity of the resource, particularly after a series of below average rainfall years.

The continuing allocation of water in the five years since the adoption of the previous Water Allocation Plan led to an estimated 26% increase in the quantity of water allocated from 4,200 ML to 5,300 ML. There has been no corresponding increase in actual volumes being used during this period, with the average annual licensed usage in the area estimated at 2,900 ML, compared with the actual usage in 1999-2000 of 3,300 ML.

Assessments completed in the preparation of this Plan have demonstrated that the resource could not sustain an increase in usage to a level of 5,300ML that would follow the activation of all allocations. In many areas, licensed sources are not able to regularly deliver the volume allocated. In areas where imported water is available, some water (taking) allocations have been exchanged for imported water. The Eyre Creek and Hutt River sub-catchments previously had allocations above their estimated sustainable limit, addressed in part by the exchange of local water for imported water. Further, water dependent development in these areas will rely on imported water or an increase in the efficiency of water use such as reducing the considerable evaporation losses from dams. Irrigation rates are relatively low in the Prescribed Area compared to other areas but there is considerable variation between users.

In some respects, the reliability of the assessment of the capacity of the resource to meet demand is limited by the quality and extent of hydrological and ecological data and analysis. While input data will be improved through further data collection and monitoring, existing data is believed to be sufficient to make a further reliable prediction of allocation limits beyond those proposed in the Plan.

Fluctuations in market forces and climate may change demand and affect the capacity of the resource to meet demand. There are no current market indicators that suggest the demand for water in the Prescribed Area will increase significantly over the life of this Plan. It is likely that any significant sustained demand adjustment would not be measurable until after the life of this Plan.

4.6 Impact of climate change on capacity of water resources

Along with much of Australia, the Prescribed Area has experienced lower than average rainfall and has been under drought conditions in recent years. This is part of a trend towards hotter and drier conditions experienced in large parts of south-eastern Australia.

Observed temperature increases in this part of Australia appears to match a general increase in recorded temperatures worldwide, with 2005 being one of the two hottest years on record in Australia and either the hottest or second hottest for the world. There is now a strong consensus that the higher temperatures observed in Australia reflect continuing global warming with climate projections indicating an average annual warming of 0.4°C to 2°C over most of Australia by 2030. Worldwide climate change is impacting on Mediterranean systems similar to those in South Australia, in a manner more severe than for most other climate types.

An enhanced Greenhouse Effect is likely to become a significant issue for the management of natural resources, and particularly water resources, within the Prescribed Area, as changes to climate are projected to be substantial. A warming/drying trend is projected for the region with decreased, more variable and unreliable rainfall, later breaks in the winter growing season, more extreme weather events and hotter, longer hot spells. The effects of hotter, drier weather, along with changes in land and water use, are reflected most clearly in stream flows and water table levels in the Prescribed Area.

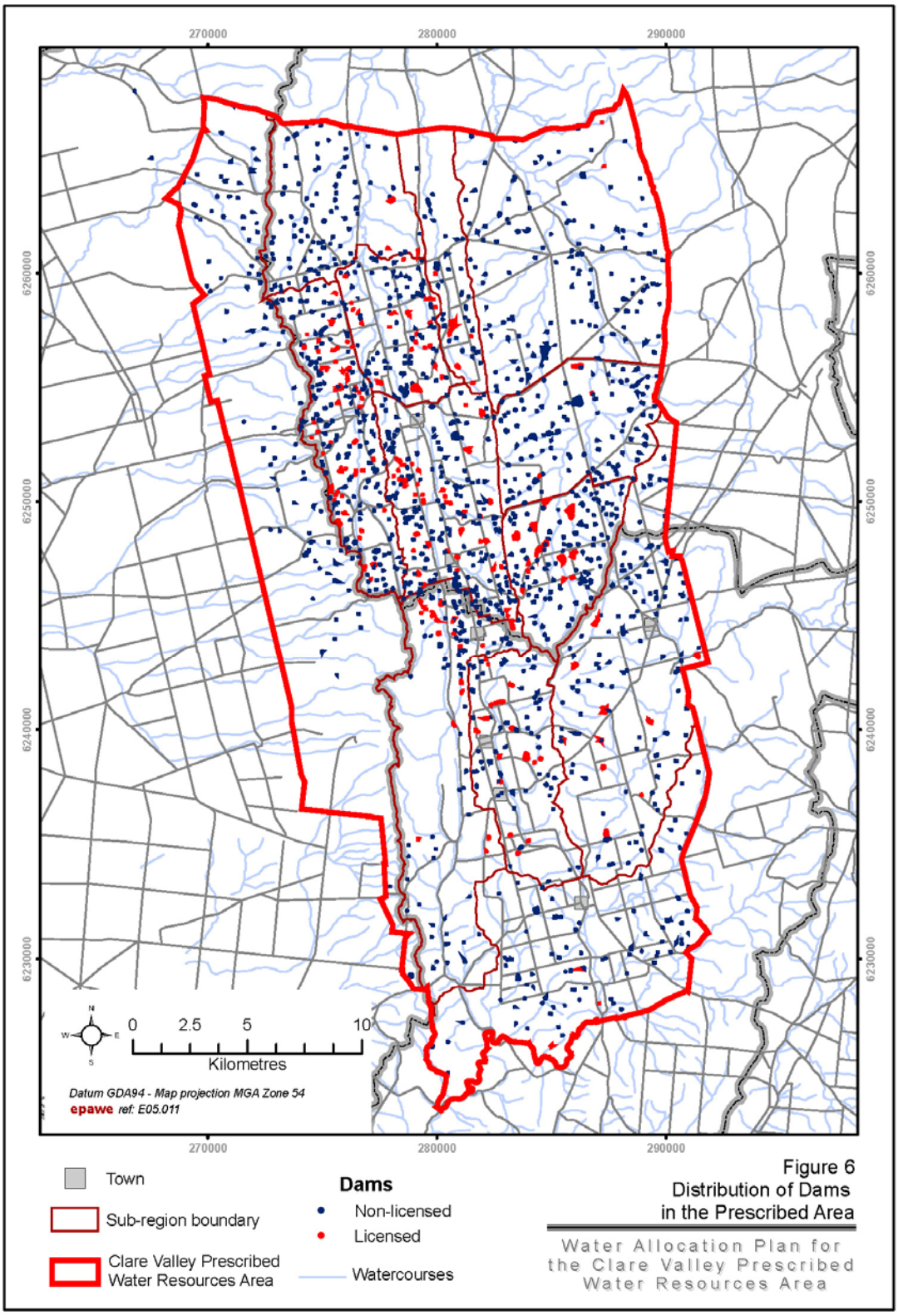
The impact of climate variability on rainfall is uncertain, as below average rainfall is not uncommon in this part of the continent and similarly low rainfall was observed across southern Australia in the early part of the twentieth century. While it is possible that recent declines in rainfall reflect trends that are independent of global climate change, it does not matter whether a sustained change in rainfall has been caused by human activity or represents a long-term natural variation. If the rainfall reduction is sustained, when coupled with enhanced evaporation that would be associated with increased

temperatures, the impact of any reduced future rainfall would be enhanced. Water management regimes will need to account for these conditions.

The management of water policy must accommodate short-term crises associated with the current drought and historical mismatches between allocations and available supply. In making short-term water policy decisions, it is critical to apply precaution with effective risk management and adaptive management and planning over longer timeframes. Longer-term policies will need to be supported by effective resource monitoring and will be driven by improved understanding of the variable and changing climate that determines the ultimate limits on the availability of water.

While the water policy decisions included in this Plan were based on the most recent meteorological, hydrological and hydrogeological information and trends, how climate change will influence the availability of water from the prescribed resources of the Clare Valley in the future is unclear at this stage and ongoing monitoring during the life of this Plan will be critical for any review of the sustainable yield for the next water allocation plan. Technical investigations should define the sustainability of the resource both under current conditions and under potential climate change.

Figure 6. Distribution of dams in the prescribed area



5 Water allocation and transfer objectives

The objectives and principles outlined in sections 5 to 7 apply to the allocation of water resources and transfers of these allocations within the Prescribed Area. In formulating these objectives, the Board has considered:

- the present and anticipated future needs of the occupiers of the land for water;
- the anticipated future capacity of land within the Prescribed Area for uses that differ from the present uses and the likely needs for water in association with those different uses;
- the likely effect of the criteria for the allocation of the prescribed water resource on the value of the land within the Prescribed Area; and
- the needs of the ecosystems that depend on the water resources.

The present need for water in the Prescribed Area is mainly domestic use, stock watering, town water supplies and irrigation. Small volumes are used for feed-lotting and other commercial enterprises. Water use for general stock watering is expected to remain relatively stable but domestic use may increase as a result of further subdivision. Irrigation will remain the largest water user by landholders in the Prescribed Area. Small growth may occur in commercial water use.

The capacity of the land to sustain existing irrigation and stock levels in the Prescribed Area is thought to be good. The capacity of the land is not considered to be the limiting factor for irrigation in the Prescribed Area, rather access to water is the limiting factor.

Generally, the basic features of the land, such as location, fertility and gradient, may be more important in determining the price of the land but the potential access to water for a licensed purpose can be a factor as well. In the lower rainfall parts of the Prescribed Area, closure to further development could certainly have an impact on land values. Land values could be lower compared to the average land price in the Prescribed Area because it would not be possible to use the land for the economically dry growing of vines. The value of land will also vary depending on whether imported water is available. Subject to permits, land adjacent to the pipeline may be able to have access to water, even if it is in a closed area for the development of the prescribed surface, watercourse and underground water resources.

5.1 Objectives

The following objectives apply to all water allocations and transfers of these allocations in the Prescribed Area.

Objective 1: Maintain and, where possible, improve the quality of the water resources within the Prescribed Area and for downstream users.

Objective 2: Provide adequate quantity and quality of water for water-dependent ecosystems.

Objective 3: Maintain, where possible, existing access to water resources for landholders throughout the Prescribed Area and downstream users outside of the Prescribed Area.

Objective 4: Protect access to water for town water supplies and water for domestic use.

Objective 5: Minimise interference between licensed water users, to ensure supply to any licence is not threatened by the allocation to another licence.

Objective 6: Enable transfers of water allocations within sustainable limits.

Objective 7: Promote the sustainable use of water for agricultural and other economic enterprises within social and environmental limits.

6 Water allocation criteria

6.1 General principles

1. Water will be allocated by volume.

2. With the exception of rollover allocations, allocations of artificially recharged water and roof runoff allocations, the allocation of water in respect of any water resource in the Prescribed Area (underground water, surface water and water in watercourses) after the date of adoption must not cause any increase in the total volume of water already allocated in the Prescribed Area.

3. Water may only be allocated in circumstances where the Minister administering the Natural Resources Management Act 2004 (the Minister) is satisfied that the proposed location of taking, and the proposed manner of taking and use of the water, will have no significant detrimental impact on:
    (a) the water resource;
    (b) water dependent ecosystems;
    (c) existing water users; or
    (d) the productive capacity of the land, including, but not limited to, the causing of dryland salinity, perched water tables less than 2 metres from the surface or waterlogging.

4. A licence must specify the site or location from which each allocation, endorsed on the licence in respect of a particular resource, may be taken.

5. Saved water will not be allocated for any purpose and must be retained within the aquifers, surface waters or watercourses.

6.2 General principles for volumetric conversion of existing allocations

6. Subject to principle 8, a water (taking) allocation or a water (holding) allocation endorsed on a licence at the date of adoption (‘existing allocation’) and expressed as a volume per annum will be reduced to 95% of that volume, and the licence will be varied accordingly.

7. Any variation of a licence to give effect to volumetric conversion in accordance with this section will occur and take effect within twelve months after the date of adoption.

8. A licence that was varied prior to the date of adoption to account for a transfer to that licence of an imported water allocation will not be subject to the reduction referred to in principle 6 but:
    (a) the licence continues to be endorsed with the existing water (taking) allocation; and
    (b) the licence will be varied so that it is also endorsed with a water (holding) allocation with a volume equal to the volume by which the

water (taking) allocation endorsed on the licence immediately before the exchange for imported water was reduced to give effect to the exchange.

9. For the purposes of this section:

- **"current theoretical allocation"** (expressed in ML) is defined as the product of the area of land (in hectares) that may be irrigated as specified on the licence and the application rate (ML/ha) if specified on the licence, or if no rate is specified then an application rate of 1 ML/ha; and
- **"maximum take"** means the actual volume of water taken (as recorded by the Minister) in any one single water use year in a specified period.

6.2.1 Volumetric conversion of surface water and watercourse water allocations

10. A licence endorsed with an existing surface water or watercourse water (taking) allocation expressed by reference to the area that may be irrigated and an application rate, will be varied so that:

10.1 the allocation is expressed as a volume per annum equal to the greater of:

(a) the maximum volume of surface water or watercourse water taken in any one single water use year in the period 1 July 2000 – 30 June 2007 (limited to the current theoretical allocation); or

(b) 80% of the current theoretical allocation for surface water or watercourse water;

providing that in either case if the allocation is endorsed for taking from a dam, the volume must be no greater than 70% of the capacity of the dam as determined by a licensed surveyor or as specified on the licence as the volume of the dam. This 70% limit does not apply to a dam that has no natural catchment and is used solely for the storage of imported water; and

10.2 in the case of a single licence endorsed with existing multiple water allocations pertaining to different sites for taking, the licence will be varied to specify the individual sites for taking to which each separate allocation relates, in accordance with the intent of this plan and taking into account:

(a) the distribution of the allocation(s) between the sites specified on the licence prior to the date of adoption;

(b) the presence of licensees authorised to take from the same resource downstream of the relevant licence holder; and

(c) the volume historically taken from each site.

6.2.2 Volumetric conversion of underground water allocations

11. Further to principle 9, and for the purposes of sub-section 6.2.2 and sub-section 6.2.3, if, at the date of adoption, one licence is endorsed with an allocation or allocations which are expressed as authorised for taking from multiple sources on the same land or contiguous land:

- **"current theoretical allocation"** means the total combined current theoretical allocations in respect of all of these sources; and

- **"maximum take"** means the actual combined volume taken from all of these sources in any one single water use year as recorded by the Minister.

12. Subject to principle 13, any licence endorsed with an existing underground water (taking) allocation expressed by reference to the area that may be irrigated and an application rate, will be varied so that:

12.1 the allocation is expressed as a volume per annum equal to the greater of:

(a) 95% of the maximum take in the period 1 July 2000 – 30 June 2007 (limited to 95% of the current theoretical allocation); or

(b) 90% of the current theoretical allocation, if that allocation was calculated from the results of an approved aquifer test conducted between 1 July 2000 and the date 3 years prior to the date of adoption of this plan; or

(c) 95% of the current theoretical allocation, if that allocation was calculated from the results of an approved aquifer test conducted no earlier than three years prior to the date of adoption; and

12.2 in the case of a single licence endorsed with an existing underground water allocation or allocations pertaining to multiple wells on the same property, the licence will be varied to specify the individual well to which each separate allocation relates, in accordance with the intent of this plan and taking into account:

(a) the distribution of the allocation between wells specified on the licence prior to the date of adoption;

(b) the presence of neighbouring wells and the resource protection zones of each of these wells calculated by principles 21.3 and 25; and

(c) the historical take from each well.

13. If, in respect of an existing underground water (taking) allocation:

(a) no water was taken in the period between 1 July 2000 and the date of adoption; and

(b) no aquifer test of the underground water source pertaining to that allocation was undertaken between 1 July 2000 and the date of adoption,

then the allocation will be reduced to zero and the licence varied accordingly.

6.2.3 Variation of underground water allocations following volumetric conversion

14. Following the variation of underground water allocations in accordance with section 6.2.2 (to achieve volumetric conversion) a licensee may apply for a further variation to the licence to increase the volume of the allocation by up to a maximum of 36 multiplied by the well yield (as defined in section 6.4) but determined with an approved aquifer test conducted between 30 June 2007 and the date 12 months from date on which the relevant licence was varied to achieve volumetric conversion. The application may be granted providing that:

(a) the further variation to the volume is no greater than 2 times the maximum take in the period 1 July 2000 – 30 June 2007, except that where the maximum take during that period was less than 45% of the current theoretical allocation and the licensee demonstrates they made a significant financial commitment to the development of infrastructure

associated with the use of the existing allocation during the period 28 October 1999 – 30 June 2007, the varied volume may be greater than 2 times the maximum take during the period 1 July 2000 – 30 June 2007; and

(b) in any case, the varied volume may be no greater than 90% of the current theoretical allocation; and

(c) where an underground water allocation has been transferred from another licence holder since 30 June 2007, the varied allocation will be 90% of the current theoretical allocation.

6.3 General principles for allocation after the date of adoption

15. From the date of adoption, the allocation of water must be consistent with the principles in Sections 6.4 – 6.7, and will be limited to:

(a) allocations resulting from the conversion of a water (holding) allocation to a water (taking) allocation;

(b) allocations resulting from the conversion of a water (taking) allocation to a water (holding) allocation;

(c) rollover allocations;

(d) roof runoff allocations; and

(e) allocations of artificially recharged water.

16. A water (taking) allocation resulting from the reversal of an imported water exchange in accordance with section 6.7 will not be subject to sections 6.3, 6.4 or 6.5 of this plan.

6.3.1 Water (holding) allocations made after the date of adoption

17. No water (holding) allocation may be endorsed on a licence after the date of adoption except:

(a) upon the conversion of the whole or part of water (taking) allocation to a water (holding) allocation, including as a result of an imported water exchange in accordance with Section 6.7; or

(b) upon the transfer of the whole or part of a water (holding) allocation from one licence to another.

18. A surface water or watercourse water (taking) allocation cannot be converted to a surface water or watercourse water (holding) allocation except where it is required for an exchange with imported water.

19. A water (taking) allocation of the following type may not be transferred or converted to a water (holding) allocation:

(a) a rollover allocation; or

(b) an allocation to take artificially recharged water except on the transfer of whole of licence.

6.3.2 Maximum taking and use of water in relation to area of land owned or occupied

20. The total volume of water from all sources that may be allocated for irrigation purposes (including imported water) should not exceed 1 megalitre per hectare

of the relevant land per annum (where the relevant land is the aggregate of all contiguous land parcels owned or leased by the applicant) unless the Minister is satisfied that the application of more than 1 megalitre of water per hectare in any specified area of the land will not:

(a) cause, or be likely to cause, a rise in the underground water level resulting in detrimental effects to structures or ecosystems; or

(b) result, or be likely to result, in adverse effects on the natural flow or quality of another water resource; or

(c) result, or be likely to result, in adverse effects to the productive capacity of the land including but not limited to, increases in land salinisation, waterlogging, or perched water tables; or

(d) adversely affect water dependant ecosystems.

6.4 Allocation of underground water after the date of adoption

21. For the purposes of this section:

21.1 "**well yield"** is the maximum rate of extraction of water (expressed in ML per 24 hours) that can be continuously taken from the well based on the pump rate that was applied during an aquifer test conducted no earlier than ten years prior to the date of adoption;

21.2 **"drawdown"** means a reduction in water level and/or pressure level in an aquifer as a result of the taking of underground water from that aquifer; and

21.3 **"resource protection zone"** means the circular area (measured in hectares) centred on a licensed well that is equal to the volume of the annual allocation in respect of that well (in ML) divided by 0.2 ML/ha.

22. For the purposes of determining well yield, the aquifer test must be:

22.1 a properly conducted aquifer test approved by the Minister such that:

(a) the drawdown of the water level in the well during the last 2 hours of the aquifer test does not exceed 2% of the total drawdown for the full 24 hours of the aquifer test; and

(b) within 24 hours after the cessation of the aquifer test, the water level in the well recovers to a distance from the original water level prior to the aquifer test that equates to no more than 5% of the total maximum drawdown; and

(c) the test does not show a detrimental impact on water levels, yield or water quality from other existing operational wells within the resource protection zone of the well being tested;

or

22.2 any other properly conducted aquifer test approved by the Minister.

6.4.1 Maximum annual allocation in respect of a well

23. For allocations made in respect of wells after the date of adoption, the maximum annual volume that may be allocated is 20 ML per annum or no more than 36.00 multiplied by the well yield (in ML per 24 hours), whichever is the lesser amount.

6.4.2 Resource protection zones for wells

24. Subject to principle 25, underground water must not be allocated for taking from a well after the date of adoption if to do so would cause the resource protection zone of that well to overlap with the resource protection zone of another well.

25. The resource protection zones of two or more wells in respect of which water (taking) allocations are held by the same licensee may overlap, in which case a "multiple well resource protection zone" will apply in respect of those wells, calculated as follows:

    (a) the area of the resource protection zone in respect of each well is initially calculated in accordance with Principle 21.3 (disregarding any overlap);

    (b) any overlap area is attributable to the resource protection zone of each well involved in the overlap, and is the total area (in hectares) of any one or more overlap(s) between that resource protection zone and any other (with the consequence that any one overlap is counted towards the total overlap area of each of the wells involved in the overlap);

    (c) the total area of overlap for each well as calculated under 25(b) is multiplied by 0.2 ML/ha to calculate an "overlap allocation" for each well;

    (d) the "overlap allocation" is added to the actual allocation in respect of each well and either that total amount (in ML/annum) or the maximum of 20ML/annum, whichever is the lesser amount, is used to calculate a revised resource protection zone for the respective well in accordance with principle 21.3 ;

    (e) the outer boundaries of the revised resource protection zones taken together become the outer boundary of a single, "multiple well resource protection zone".

26. In addition to principle 24, underground water may only be allocated as a water (taking) allocation in respect of a well after the date of adoption (other than in the variation of an allocation under section 6.2.2) if the well's resource protection zone does not overlap with or fall within:

    (a) the boundary of an underground water exclusion zone around a permanent pool or a permanent flowing stream, as indicated on Figure 7; or

    (b) the boundary of an underground water exclusion zone around the towns or settlements of Mintaro, Watervale, Penwortham, Sevenhill, Armagh or Leasingham as indicated on maps in Appendix 1.

27. Principle 24 does not apply to underground water (taking) allocations granted or applied for prior to the date of adoption and not transferred with a change in the location of the taking of the water since the date of adoption, or allocations varied under 6.2.2.

6.4.3 Changing the site for taking an underground water allocation

28. The site specified on a water licence as the site for the taking of an underground water allocation endorsed on that licence may be changed in respect of some or all of that allocation where either:

    (a) there is no change to the total volume of water allocated or to the conditions of the licence; and

(b) the proposed new site for taking is not more than 20 metres from the original site specified in respect of the water (taking) allocation; and

(c) the proposed new site is on land in the same ownership as the land on which the original site is located;

or the allocation (or portion of the allocation) is transferred to another licence.

29. A change in the site of taking of an underground water allocation in accordance with principle 28 is exempt from the application of the principles in section 6.4.2.

6.5 Allocation of surface water and water from watercourses after the date of adoption

6.5.1 Surface and watercourse water rollover

30. With the exception of roof runoff (surface water), the volume of a surface water allocation or a watercourse water allocation that has not been taken or transferred in a given water use year ("the credit year") constitutes a "rollover credit".

31. A rollover credit will be converted to a rollover allocation and may be taken in addition to the annual allocation endorsed on the licence as a taking allocation for a given water use year, subject to the following:

(a) a rollover allocation is the sum of any rollover credits from the immediately preceding three credit years that were not converted and taken as rollover allocation during that period;

(b) a rollover allocation cannot be taken until the full amount of the water (taking) allocation for that year has been taken;

(c) rollover credits will be converted to rollover allocations in the order they accrue; and

(d) a rollover allocation shall not exceed 25% of the volume of the surface water allocation or watercourse water allocation from which the rollover credit was derived.

(e) unless converted and taken as a rollover allocation, a rollover credit expires at the end of the third full water use year after the credit year.

6.5.2 Allocation of water taken by off-stream dams

32. Water may only be allocated for taking and storage in an off-stream dam on condition that:

(a) Where the catchment for the point of taking is greater than or equal to 800 hectares the maximum volume of water that may be pumped or diverted at anytime must not exceed 50% of the flow that exceeds the threshold flood flow rate of the water, that is passing the point of diversion;

(b) Where the catchment of the point of taking is less than 800 hectares the maximum volume of water that may be pumped or diverted at anytime must not exceed 50% of the flow that exceeds the threshold flow rate of the water, that is passing the point of diversion; and

(c) the maximum rate (in litres/second) to divert, or pump, water to the dam does not exceed the rate determined by substituting the numerical value

of the lesser of 3 times the allocation or 1.5 times the dam volume (defined in ML).

6.5.3 Allocation of water taken by on-stream dams

33. Water may only be allocated for taking and storage in an on-stream dam on condition that the source of taking is not a restricted watercourse.

6.5.4 Allocation of roof runoff (surface water)

The principles in this sub-section apply to the allocation of roof runoff (surface water) only. They are in addition to the general objectives and principles outlined in sections 6.1 and 6.3.

34. Water may only be allocated as roof runoff (surface water) where runoff from a minimum of 15% of the connected roof area is returned to the environment:
    (a) by as close as practicable to the natural path;
    (b) as soon as reasonably practical following precipitation; and
    (c) in a manner that does not cause significant detrimental impacts to the environment, including but not limited to erosion.

35. The maximum volume that may be allocated shall not exceed the volume determined by:

$$\frac{\text{connected roof area } (m^2) \times \text{rainfall (mm)} \times 0.85}{1000}$$

Where:

rainfall = average annual rainfall (in mm) determined in accordance with the Notice of Authorisation to Take Water of 9 March 2006 (South Australian Government Gazette 16 March 2006 pg 906) or its successors.

36. Allocation of roof runoff (surface water) shall be referenced as such on the licence and shall remain as that type of allocation.

6.5.5 Protection of ecosystems

37. Despite any other allocation principle, no allocation may be made after the date of adoption for the taking of water from a permanent pool or a permanent flowing stream as delineated in Figure 7.

6.6 Allocation of artificially recharged water

38. If water that has been artificially recharged in one water use year in accordance with a permit granted under Section 135 of the Act and/or an authorisation granted under the Environmental Protection Act 1993, a volume (not exceeding 60% of the volume recharged as recorded by a meter in that water use year) may be allocated for taking in the following water use year, subject to the following conditions:

    38.1 the taking and use of artificially recharged water from the proposed point of extraction must not lower the level of underground water to a level that will detrimentally affect the ability of existing users to lawfully take

from that underground water or detrimentally affect any ecosystems that depend on that underground water;

38.2 the taking and use of artificially recharged water from a proposed point of extraction must not cause degradation, through increased soil salinity, soil erosion or any other means, of the land from under which the water is taken or on which it is used; and

38.3 the taking of artificially recharged must not cause a decrease in the amount or duration of discharge from the underground water to streams or springs and must not detrimentally affect any ecosystems that depend on that discharge.

38.4 unless taken beforehand, an allocation of artificially recharged water expires within two years.

6.7 Exchange of water for use of imported water

39. The holder of a water licence endorsed with an allocation or allocations in respect of a water resource in a sub-region in which the existing underground water salinity trend indicates that salinities are steady or increasing may apply for a permit to use imported water in the sub-region in which the existing allocation is used, on the basis that they also apply to exchange all or part of the allocation(s) endorsed on their licence in accordance with this section for the right to use imported water in accordance with a permit. This process is referred to as an "imported water exchange". Where existing underground water salinity trends indicate that salinity is steady or increasing, strict permit conditions pursuant to section 8.9 of this plan apply.

40. A licensee may make an application for an imported water exchange by:

(a) applying to convert ("exchange application") all or part of a surface, watercourse or underground water (taking) allocation ("exchange allocation") in respect of the relevant sub-region to a water (holding) allocation; and

(b) applying for a permit to use a volume of imported water calculated as equivalent to the exchange allocation in terms of salinity impacts by applying the relevant "exchange rate".

The two applications will be assessed and determined together in accordance with the principles in this section and in section 8.9, and both applications must be granted for the exchange to be effective.

Exchange rates apply to the sub region from which water is taken.

For the purposes of this section, the Minister will publish, by notice in the South Australian Government Gazette:

- details of the relevant salinity trends for each sub-region; and
- a list of the relevant exchange rates by volume (based on equivalent salinity) between imported water and underground water, surface water and watercourse water applying in each of the sub-regions, together with the relevant salinities of each source,

and from time to time as practicable, will revoke each notice and publish a new notice with the updated details on salinity trends and exchange rates.

41. Rollover allocations, allocations to take artificially recharged water, and allocations held for a limited period may not be the subject of an exchange application.

42. The maximum volume of water that may comprise an exchange allocation is the average of the total volume of water taken in accordance with the licence over the preceding four complete water use years, as determined by water meter readings by or on behalf of the Minister. Where meter readings over four complete water use years are not available or are incomplete, the maximum volume will be the average of the readings for the water use year(s) available, but a minimum of one metered water use year is required to enter into an exchange.

43. If an exchange application is granted, it will be given effect by the conversion to a water (holding) allocation(s) of:

    (a) the portion of the water (taking) allocation that is the subject of the application i.e. the exchange allocation; and

    (b) the portion (if any) of the water (taking) allocation endorsed on the licence that exceeds the average volume taken as calculated pursuant to principle 42.

44. A water (holding) allocation(s) resulting from an imported water exchange:

    (a) must not be taken or used;

    (b) must not be transferred, except as a whole of licence transfer or as a transfer to a new owner or lessee of the relevant land in accordance with principle 49 or principle 50; and

    (c) may only be converted back to a water (taking) allocation in accordance with principle 47.

45. An exchange application will be granted where:

    (a) the criteria for the grant of a permit for imported water are met, other than principle 119(b)(ii); and

    (b) the applicant can demonstrate to the Minister's satisfaction that the volume of surface water or watercourse water that is subject to the exchange (i.e. converted to water (holding) allocation(s)) will not be taken elsewhere in the sub-region, whether by direct extraction, or by diversion or collection in a storage facility downstream. In this matter, the onus is on the applicant to negotiate with other landholders to ensure the passage of exchanged surface water or watercourse water out of the sub-region.

46. An imported water exchange in which the exchange allocation comprises an underground water allocation in respect of a well or wells does not change or remove the resource protection zone (referred to in section 6.4) of the well(s).

47. A licensee may apply to reverse all or part of an imported water exchange by:

    (a) making an application to convert all or part of the relevant exchange allocation from a water (holding) allocation to a water (taking) allocation; and

(b) if the application is to reverse the whole of the exchange, providing the Minister with written consent to vary the expiry date of the permit with effect that the permit will expire on the same date on which the application in (a) is granted, or, if the application is to reverse part only of the exchange, applying to vary the permit with effect that the volume of imported water authorised for use is reduced by the volume that represents the portion of the exchange allocation to be reversed. The calculation of the portion of the exchange allocation to be reversed is based on the exchange rate used at the time of the initial exchange.

The two applications will be assessed and determined together, and both must be granted for the reversal to be effective.

48. Pursuant to principle 47, where a licensee

(a) applies to reverse all of an imported water exchange, the allocation reverts back to the volume and the source endorsed on the licence at the time of the initial exchange; or

(b) where the licensee applies to reverse part of an imported water exchange, the allocation reverts back to the volume that represents the portion of the exchange allocation to be reversed and to the source endorsed on the licence at the time of the initial exchange.

Figure 7. Permanent pool underground water exclusion zones in the Prescribed Area

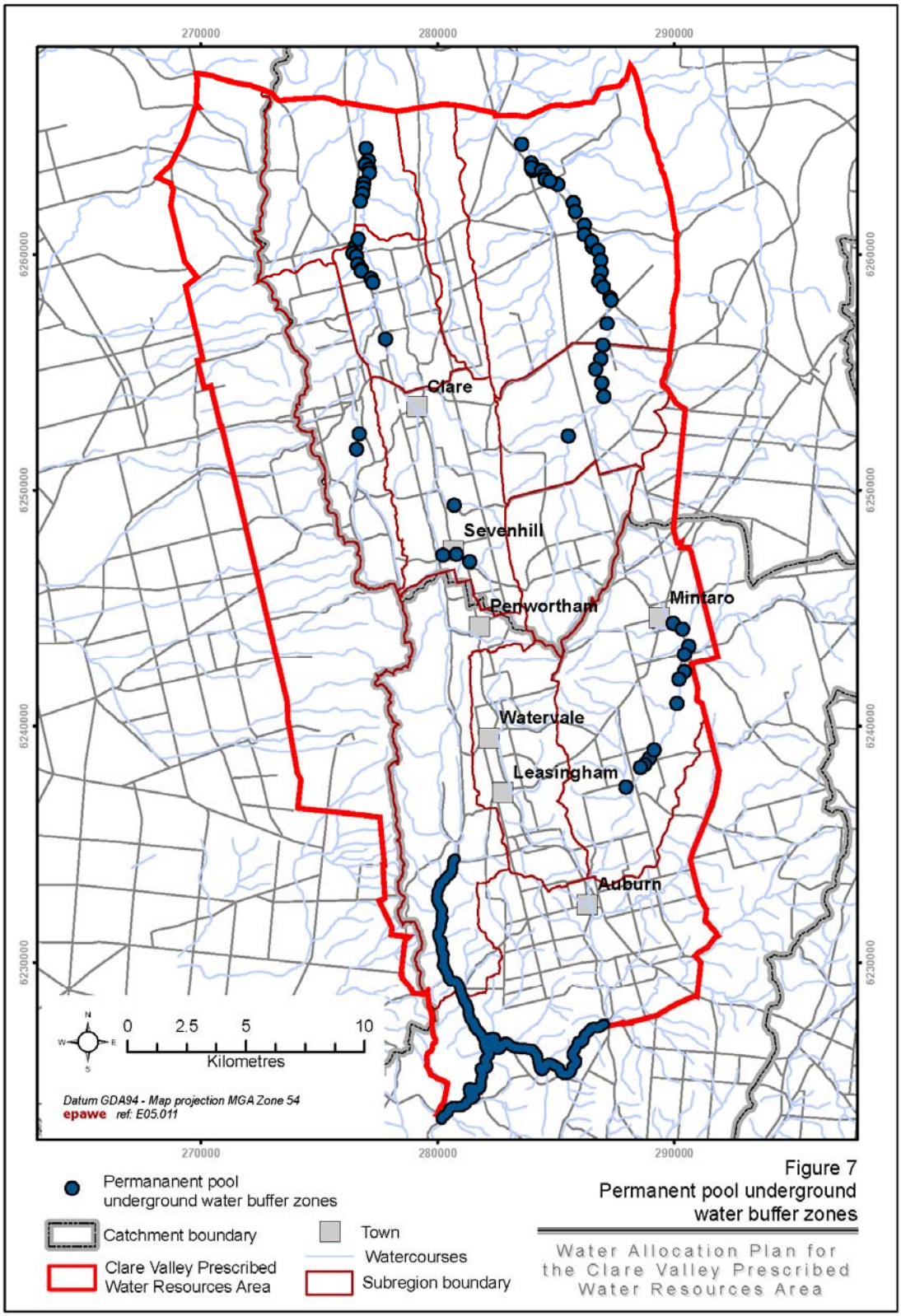


Figure 8. Restricted watercourses

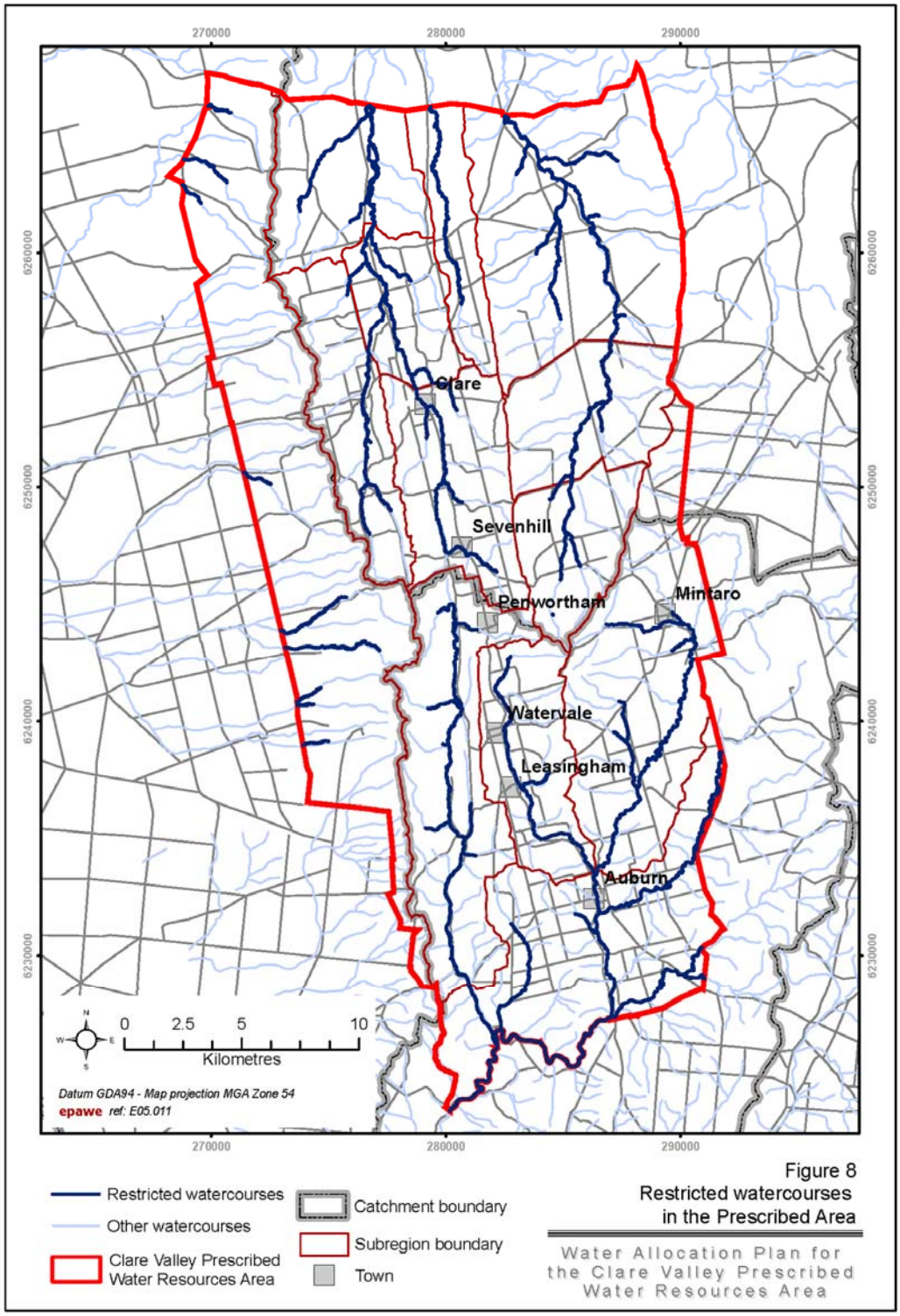
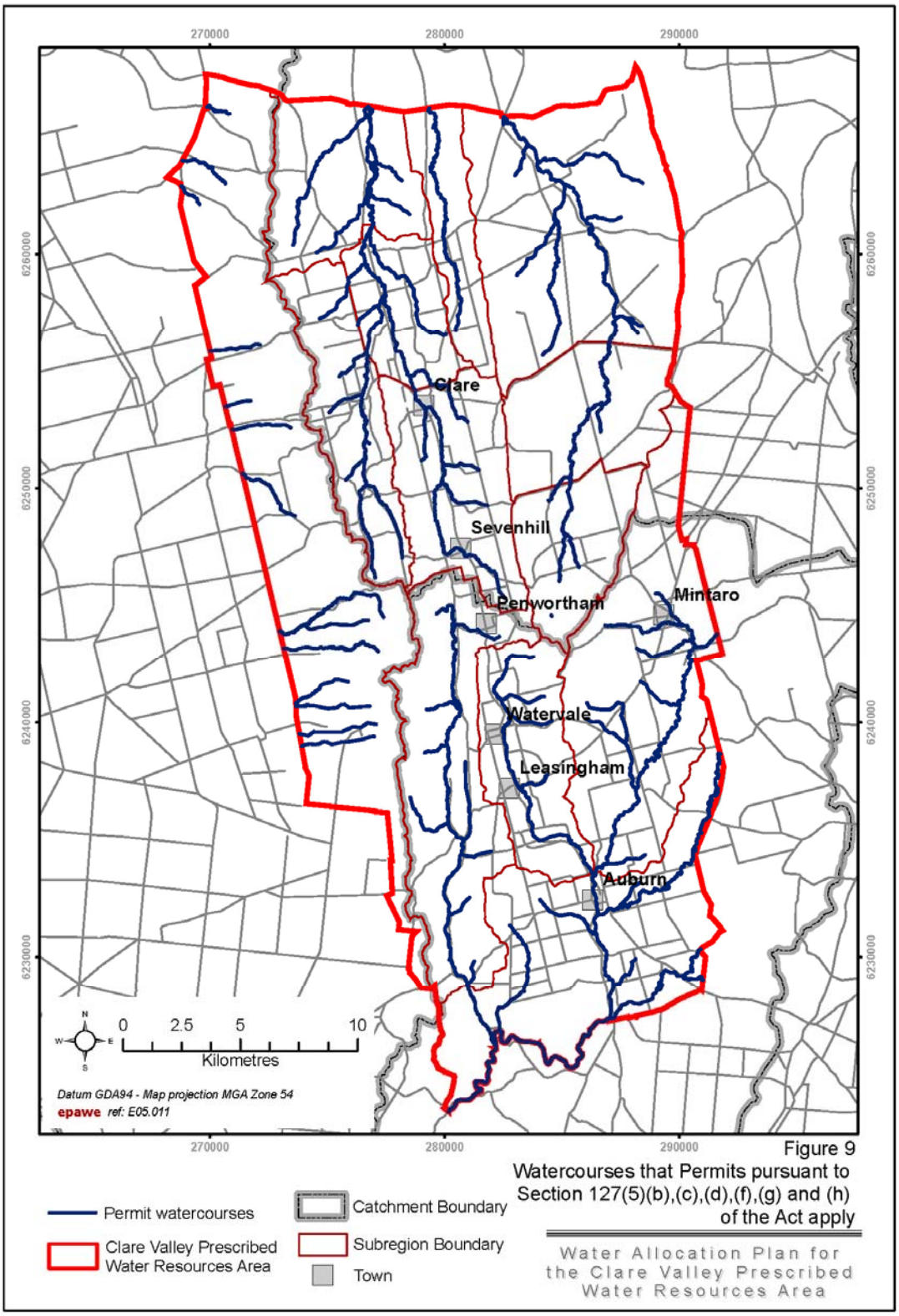


Figure 9. Watercourses that permits pursuant to section 127(5)(b),(c),(d),(f),(g) and (h)of the Act apply



7 Transfer criteria

The following principles apply to the transfer of water licences and / or allocations in the Prescribed Area.

7.1 General transfer principles

49. An allocation (whether holding or taking) in respect of one kind of water resource, that is: underground water, surface water or watercourse water, may only be transferred to and endorsed on another licence as an allocation in respect of the same kind of resource.

50. A transfer of all or part of a water (holding) allocation is not subject to the transfer criteria in sections 7.2 – 7.5.

51. In the case of either the transfer of the whole of an allocation to another licence or the transfer of a licence including its entire allocation(s) to another person, and where there is no variation to the location from which the water is authorised to be taken, the transfer criteria in sections 7.2 – 7.5 do not apply.

7.2 Transfers of underground water

52. Subject to principle 53, the transfer of underground water allocations must be assessed against and comply with the criteria for the allocation of underground water in section 6.4.

53. Principle 52 does not apply to the transfer of water (taking) allocations of underground water where there is no change to the location of the point of taking or to the volume of water allocated or to the conditions of the allocation.

54. An allocation of underground water may only be transferred to a licence to take from a different point of taking (whether it is to be held as a taking allocation or a holding allocation) if the results of an aquifer test (conducted to the approval of the Minister no earlier than 10 years prior to the date of the application) demonstrate that the well yield of the new point of taking is sufficient to provide the volume that is to be transferred in addition to any amount already allocated for extraction from that point of taking.

55. In the case of a transfer of the whole or part of an underground water (taking) allocation from a licence in respect of one well to a licence in respect of another well for a limited period, the resource protection zones of both wells will be unaffected by the limited period transfer.

7.3 Transfers of surface water and water from watercourses

56. Subject to principle 57, the transfer of allocations of surface water and water from watercourses must be assessed against and comply with the criteria for the allocation of surface water and water from watercourses in section 6.5.

57. Principle 56 does not apply to the transfer of water (taking) allocations of surface water and water from watercourses where there is no change to the location of the point of taking, or to the volume of water allocated or to any facility in which the water is to be stored.

58. An allocation of surface water or water from a watercourse may be transferred, in whole or in part, subject to the following:

58.1 the proposed point of taking must be downstream of the original point of taking of water, where the original point of taking is the location that was authorised for taking on the date of adoption; and

58.2 if the allocation is a combination of a number of other allocations or parts of allocations, the proposed point of taking must not be upstream of the most downstream of the original points of taking; and

58.3 transfers of allocation (whether whole or in part) between licences pertaining to different dams within a sub-region may not be approved unless the relevant authority is satisfied that, consistent with the criteria for a permit under section 8.2 of this plan, there has been a reduction in the capacity of the dam to which the licence endorsed with the allocation proposed for transfer pertains, by a volume equal to or greater than the capacity of a new dam constructed for the allocation purposes of the proposed transfer.

58.4 with the exception of transfers of surface water or watercourse water in accordance with principle 57, allocations may only be transferred if the dam proposed for storage following transfer is:

(a) an off-stream dam that;

(i) is downstream of the original dam; and

(ii) has a maximum capacity that does not exceed either the volume of twice the cumulative total of all allocations in respect of the dam or the dam volume specified on the licence; or

(b) an existing on-stream dam that:

(i) is downstream of the original dam;

(ii) is not on a restricted watercourse as per Figure 8;

(iii) will not be increased in capacity; and

(iv) has a maximum capacity that does not exceed either the volume of twice the cumulative total of all allocations in respect of the dam or the dam volume specified on the licence.

59. If the dam from which a surface water allocation is transferred in accordance with principles 56 and 57 is to be used for stock watering purposes or domestic purposes only, and subject to the satisfaction of the criteria for a permit under section 8.2, the capacity of the dam must be no greater than 5 ML in the case of stock purposes and no greater than 2 ML in the case of domestic purposes.

7.4 Allocations that may not be transferred or converted

60. A water (taking) allocation of the following type may not be transferred or converted to a water (holding) allocation:

(a) a rollover allocation; or

(b) an allocation to take artificially recharged water except on the transfer of whole of licence.

61. A water (holding) allocation resulting from an imported water exchange may not be transferred with the exception of a whole of licence transfer.

62. An allocation of roof runoff (surface water) may not be transferred except where there is no change to the location to the point of taking.

63. A surface water or watercourse water (taking) allocation cannot be converted to a surface water or watercourse water (holding) allocation except where it is required for an exchange with imported water.

7.5 Variation of an authorisation to use imported water

64. If the whole of the land to which a permit to use imported water ('the original permit') applies is sold or leased, then the original permit may, on application by the new owner or lessee with evidence of the transfer or lease, be varied so that the permit indicates that it operates for the benefit of the new owner or lessee.

65. If a part of the land to which a permit to use imported water ('the original permit') applies is sold or leased, then:

(a) the original permit must be amended with effect that the volume of imported water authorised for use is reduced to the extent necessary to ensure that the criteria for the grant of a permit in Section 8.9 are met; and

(b) the new owner or lessee of the sold or leased portion of the land will have first priority for a period of three months from the date of purchase in respect of any application for a permit to use a volume of imported water equal to the volume by which the original permit volume was reduced, provided that:

(i) such volume may only be used on the same portion of the land that was sold or leased and on the same conditions as endorsed on the original permit; and(ii) if the original permit resulted from an imported water exchange, the new owner or lessee also acquires from the original permit holder the relevant exchange allocation.

8 Permits

A person can only undertake any of the activities listed in this section if authorised to do so by a permit granted by the relevant authority.

Permits will only be granted if the activity complies with the relevant objectives and principles of this section.

For the purposes of this plan the relevant authority is

(a) in the case of an activity referred to in Sections 127(3)(a), (b), or (c), or Sections 127(5)(i) or (j) of the Act – the Minister;

(b) in the case of an activity referred to in Section 127(3)(d) of the Act – the Minister until such time as the Regional Natural Resources Management Plan is adopted by the Minister and the Minister provides the appropriate certificate to confirm this, after which time it is the Board; and

(c) in the case of an activity referred to in Sections 127(5)(b), (c), (d), (f), (g), and (h) of the Act – the Board.

8.1 Objectives

The following objectives apply to all water affecting activities within the boundary of the Prescribed Area.

Objective 1: Protect the quantity and quality of water resources and the maintenance of natural hydrological systems and environmental flows.

Objective 2: Prevent deterioration in the quality of surface water, underground water or water in watercourses or lakes.

Objective 3: Protect and restore the natural character of watercourses and floodplains.

Objective 4: Protect the ecological functions of water resources and dependent biological diversity.

Objective 5: Protect watercourses and lakes against pollution, erosion and habitat destruction as a result of any construction or the depositing or placing of an object or solid material in a watercourse or lake.

Objective 6: Ensure that dams or other water storage or diversion structures are constructed and managed in a manner which:

- protects downstream users;
- protects water quality and quantity;
- protects ecosystems dependent on these resources; and
- are not located in areas which may cause waterlogging to adjacent public or private property.

Objective 7: Ensure that the construction and management of buildings and structures do not damage the ecology of watercourses or lakes

in the Prescribed Area and ensure that natural flows are maintained.

Objective 8: Keep watercourses and lakes free of obstructions that may impede natural stream flow or cause unnecessary flooding.

Objective 9: Ensure any object or solid material placed on the flood plain to provide flood protection is appropriate.

Objective 10: Retain vegetation of watercourses, associated riparian zones and floodplains to maintain bed and bank stability, protect biodiversity, protect habitat, maintain water quality and minimise flooding.

Objective 11: Preserve the geomorphic characteristics of watercourses and floodplains.

Objective 12: Ensure no negative impacts on the productive capacity of land or water dependent ecosystems from the taking and use of imported water.

Objective 13: Minimise interference between wells and the effect of well construction on native underground water including minimising:

- the impact of well location on water levels;
- the impact of drilling, sealing, backfilling or plugging of wells on the water resource; and
- the impact of repair, replacement or alteration of the casing, lining or screen of wells on the water resource.

Objective 14: Ensure any water discharged to the environment is of suitable quality to:

- sustain the existing uses of the water; and
- protect ecosystems dependent on these resources.

Objective 15: Ensure any water drained or discharged directly or indirectly into a well does not adversely affect the underground water quality, the aquifer or any ecosystem that depends on that water.

Objective 16: Use alternative sources of water including imported water and effluent in a manner that does not adversely impact on the quantity and quality of water resources in the Prescribed Area; or downstream areas; or the productive capacity of land; or water dependent ecosystems.

Objective 17: Ensure no negative impacts on the productive capacity of land or water dependent ecosystems from the application of alternative sources of water including imported water and effluent.

Objective 18: Activities shall not compromise the installation and maintenance of erosion control structures.

8.2 Water storage and diversions

A permit is required, pursuant to Section 127(3)(d) of the Act, for the erection, construction, modification, enlargement or removal of a dam, wall or other structure that will collect or divert for any purpose:

(a) water flowing in a watercourse in the Prescribed Area; or

(b) surface water flowing over land in the Prescribed Area, except for roof runoff exempted by the Notice of Authorisation to Take Water dated 9 March 2006 (South Australian Government Gazette 16 March 2006 pg 906) or its successors.

66. A permit for the erection, construction or enlargement of a dam, wall or other structure that collects or diverts water within a sub-region may be granted only if:

(a) the relevant authority is satisfied that the total capacity of water capable of being retained by other dams, walls and structures already existing in the sub-region has been reduced by a volume equal to or greater than the proposed capacity of the proposed dam, wall or other structure;

(b) the volume of dam development in the sub-region at the time of the application for a permit to construct the dam is not in excess of the "Volume of Dam Development" recorded in Table 11;

(c) the density of dam development in the catchment of the proposed dam is not in excess of 0.2 ML of dam capacity per hectare;

(d) the proposed location is not in any catchment of the Prescribed Area that has a density of dam development in excess of 0.2 ML of dam capacity per hectare;

(e) the construction of the dam will not cause dam development in any catchment to exceed 0.2 ML of dam capacity per hectare;

(f) the capacity of the dam is to be less than 0.2 ML of dam capacity per hectares of land owned by the proponent in the catchment of the proposed dam, reduced by the volume of existing dam(s) on any property owned by the proponent in the catchment of the proposed dam; and

(g) the capacity of the dam is to be no greater than 2 ML if the dam is for domestic purposes and the capacity of the dam is to be no greater than 5 ML if the dam is for watering stock other than stock subject to intensive farming.

8.2.1 Type

67. Dams must only be constructed as off-stream dams.

68. Other than for capturing water for domestic use and/or for watering stock other than intensively farmed stock, a dam can only be constructed where a water (taking) allocation for surface water has been granted for taking and use of water from the point of taking of the proposed dam.

8.2.2 Location

69. Dams must not be constructed:

(a) in ecologically sensitive areas;

(b) in areas affected by salinity;

(c) in areas prone to erosion; or

(d) within a sub-region or catchment that has reached the maximum limit for dam development.

8.2.3 Sizing

70. A dam must only be constructed for the taking of a surface water or watercourse water (taking) allocation if the capacity of the dam is no more than 2 times the volume of that allocation.

8.2.4 Construction

71. Dams must be constructed and maintained adequately to prevent seepage, minimise the loss of soil through soil erosion and to minimise the accumulation of silts behind the dam.

72. Dams must be designed and constructed to optimise water quality and enhance biodiversity.

73. An off-stream dam, wall or structure must:
    (a) include a device to measure flow in the watercourse or the flow of surface water from which the diversion is to be made;
    (b) include a device that prevents the diversion from the watercourse or drainage path during periods of flow at or below the threshold flow rate or threshold flood flow rate;
    (c) be designed and constructed to ensure its operation is automated and can not be manually overridden; and
    (d) include a mechanism that records the period and the rate at which the diversion or pumping of water has occurred.

8.2.5 Maintenance of dams

74. Excavation of material ("de-silting") from a dam to maintain the capacity of the dam shall require a permit, except where that excavation is only of unconsolidated material deposited since the construction of the dam or material deposited since the dam was previously desilted.

75. Excavation of material ("de-silting") from a "turkey nest" dam is exempted from principle 74.

8.2.6 Flow regime

76. Collection or diversion of water flowing in a watercourse or over land must not adversely affect downstream water dependent ecosystems by causing reduced stream flow duration, lengthened periods of no or low flow, or other such impacts.

77. Any overflow from a dam or water diverted by a low flow by-pass must be allowed to flow naturally and must be allowed to freely exit the property that is the subject of the permit.

78. Any overflow from a dam or water diverted by a low flow by-pass must not increase flooding upstream or downstream and must remain in the watercourse or drainage path or, as appropriate, re-enter the original watercourse or drainage path on the property of the dam before exiting that property.

79. The dam, wall or structure must be maintained in such a condition that it prevents the diversion from the watercourse or drainage path during periods of flow at or below the threshold flow rate or threshold flood flow rate as outlined in principle 73(b). This includes ensuring that any device that prevents the diversion from the watercourse or drainage path during periods of flow at or below the threshold flow rate or threshold flood flow rate is effective and not obstructed in any way.

80. If the taking includes the diversion of either surface water or water from watercourses, the diversion structure must be operated in a way that meets all of the conditions defined in the original permit unless otherwise directed and must be maintained in a condition to ensure that it works to specification.

8.2.7 Dams and water storages for purposes other than storage of licensed water

The following principles are in addition to principles 66 – 80.

81. A dam or water storage not associated with the licenced taking of water can only be constructed if;

    (a) the proposed location of the dam or storage is not within 500 metres of a SA Water supply pipeline on contiguous land, i.e. land adjoining the pipeline; or
    (b) there is insufficient or inadequate water available from wells that could be established on the site or on contiguous land owned by the proponent, subject to principle 140; or
    (c) the flow rate of water from the wells is less than 0.1 litre/sec; or
    (d) the salinity of the water from the wells is greater than 1500 mg/l for general domestic purposes, or 1000 mg/l if the water is used for drinking purposes; or
    (e) the salinity of the water from the wells is greater than 3,000 mg/l for stock.

82. A dam for stock and/or domestic purposes shall only be constructed or created from an existing dam modified under principles 58 and 59 following a transfer of a water allocation if:

    (a) the level of dam development in the catchment of the proposed dam is not in excess of 0.2 ML of dam capacity/ha catchment; and
    (b) it is not in a catchment that has a level of dam development in excess of 0.2 ML of dam capacity/ha of catchment; and
    (c) the construction of the dam does not cause the level of dam development within any catchment to exceed 0.2 ML of dam capacity/ha of catchment.

83. A dam for stock and/or domestic purposes shall only be constructed or created from an existing dam modified under principles 58 and 59 following a transfer of a water allocation if:

    (a) the capacity of the dam is to be less than 0.2 ML of dam capacity / hectares of land owned by the proponent in the

catchment, reduced by the volume of existing dams on any property owned by the proponent in the catchment; and

(b) the capacity of the dam is to be less than 2 ML if the dam is for domestic purposes and the capacity of the dam is to be less than 5 ML if the dam is for stock purposes.

8.2.8 Contour banks

84. A permit is not required for contour banks which collect or divert water, provided that:

(a) the activity is undertaken in accordance with Best Operating Practices that have been endorsed by the Board; and

(b) before undertaking the activity, the person proposing to undertake the activity has obtained a certificate from the Board certifying that, in the Board's opinion, the person complies with Best Operating Practices that have been endorsed by the Board in relation to the activity.

85. For the purposes of principle 84(b), a certificate issued by the Board is valid for 12 months from the date of issue or for such shorter period of time as specified by the Board.

86. A certificate issued by the Board in accordance with principle 84 may be cancelled by the Board where, in the Board's opinion, the person to whom the certificate was issued no longer complies with Best Operating Practices that have been endorsed by the Board in relation to the activity, or in any other circumstances as the Board thinks fit.

87. The Board may refuse to issue a certificate in accordance with principle 84(b) to a person who, in the Board's opinion, has contravened or failed to comply with Best Operation Practices that have been endorsed by the Board or in any other circumstances as the Board thinks fit.

8.3 Building or structure in a watercourse, lake or on a floodplain

A permit is required for the erection, construction or placement of any building or structure in a watercourse, lake or on the floodplain of a watercourse pursuant to Section 127(5)(b) of the Act.

88. An activity under this sub-section must not be located where it will have a detrimental impact on the water dependent ecosystems, for example, but not limited to, habitat destruction, alteration of flows or affecting migration.

89. The design must take account of watercourse or floodplain erosion and subsequent construction of a building or structure must not result in watercourse or floodplain erosion.

90. The construction of a building or structure must not lead to rising water tables and salinity.

91. Structures that impede the flow of water, such as weirs, must be designed and constructed to provide low flow by-pass mechanisms.

92. The construction of a building or structure on the floodplain of a watercourse or near the bank or shore of a lake to control flooding from the watercourse or lake must not increase the risk of flooding (including upstream or downstream).

93. A permit is not required under this sub-section where:

    (a) the building or structure will be erected, constructed or placed no less than 40 metres from the banks of a watercourse and the building or structure does not take water or is not associated with the taking of water; or

    (b) the Board has provided financial or any other form of assistance in relation to the erection, construction or placement of the building or structure pursuant to section 42 of the Act; or;

    (c) the building or structure will be erected, constructed or placed in a watercourse or the floodplain of a watercourse not delineated on Figure 9.

94. A permit is not required to erect, construct or place a culvert, bridge or any other work in connection with a road in a watercourse or lake or on the floodplain of a watercourse, provided that:

    (a) the activity is undertaken in accordance with Best Operating Practices that have been endorsed by the Board; and

    (b) before undertaking the activity, the person proposing to undertake the activity has obtained a certificate from the Board certifying that, in the Board's opinion, the person complies with Best Operating Practices that have been endorsed by the Board in relation to the activity.

95. For the purposes of principle 94(b), a certificate issued by the Board is valid for 12 months from the date of issue or for such shorter period of time as specified by the Board.

96. A certificate issued by the Board in accordance with principle 94 may be cancelled by the Board where, in the Board's opinion, the person to whom the certificate was issued no longer complies with Best Operating Practices that have been endorsed by the Board in relation to the activity, or in any other circumstances as the Board thinks fit.

97. The Board may refuse to issue a certificate in accordance with principle 94(b) to a person who, in the Board's opinion, has contravened or failed to comply with Best Operation Practices that have been endorsed by the Board or in any other circumstances as the Board thinks fit.

8.4 Draining or discharging water into a watercourse or lake

A permit is required for the draining or discharging of water directly or indirectly into a watercourse or lake, pursuant to Section 127(5)(c) of the Act.

98. Discharge of water directly or indirectly into a watercourse or lake must not cause erosion or adversely affect ecosystems or the quality of receiving water, for example, but not limited to, by causing pollution or increasing the salinity levels in the watercourse or lake, or causing flooding upstream or downstream.

99. Any discharge of water directly or indirectly into a watercourse or lake should be less saline than 1,000 mg/L and must be less saline than the receiving water in the watercourse or lake at the time of discharge.

100. A permit is not required under this sub-section where:

(a) the Board has provided financial or any other form of assistance in relation to the draining or discharging of water directly or indirectly in to a watercourse or lake pursuant to section 42 of the Act;

(b) the draining or discharging of water is into a watercourse not delineated on Figure 9; or

(c) involves draining or discharging water of better quality than the receiving waters and the volume of the water drained or discharged does not exceed a volume of 0.5 ML.

101. A permit is not required for the draining or discharging of water directly or indirectly into a watercourse or lake, provided that:

(a) the activity is undertaken in accordance with Best Operating Practices that have been endorsed by the Board; and

(b) before undertaking the activity, the person proposing to undertake the activity has obtained a certificate from the Board certifying that, in the Board's opinion, the person complies with Best Operating Practices that have been endorsed by the Board in relation to the activity.

102. For the purposes of principle 101(b), a certificate issued by the Board is valid for 12 months from the date of issue or for such shorter period of time as specified by the Board.

103. A certificate issued by the Board in accordance with principle 101 may be cancelled by the Board where, in the Board's opinion, the person to whom the certificate was issued no longer complies with Best Operating Practices that have been endorsed by the Board in relation to the activity, or in any other circumstances as the Board thinks fit.

104. The Board may refuse to issue a certificate in accordance with principle 101(b) to a person who, in the Board's opinion, has contravened or failed to comply with Best Operation Practices that have been endorsed by the Board or in any other circumstances as the Board thinks fit.

8.5 Object or solid material in a watercourse or lake

A permit is required for depositing or placing an object or solid material in a watercourse or lake, pursuant to Section 127(5)(d) of the Act.

105. Depositing or placing an object or solid material in a watercourse or lake may only occur where it includes:

(a) the construction of an erosion control structure, for example, but not limited to, a rock chute or rip rap; or

(b) devices or structures used to extract or regulate water flowing in a watercourse, for example, but not limited to, diversion weirs; or

(c) where it is incidental to monitoring of the water resource or data-collection, for example, but not limited to, flow measuring devices.

106. Any object or solid material used in the control or prevention of watercourse erosion must be designed on the basis of the individual site and not:

(a) increase erosion upstream or down stream;

(b) increase water tables and salinity; or

(c) cause detrimental impacts on water dependent ecosystems, for example , but not limited to, habitat destruction, alteration of flows or affecting species migration.

107. A permit is not required under this sub-section where:

(a) the Board has provided financial or any other form of assistance in relation to the depositing or placing an object or solid material in a watercourse or lake pursuant to section 42 of the Act;

(b) the proposed activity involves a non polluting object or solid material that occupies less than 5 percent of the cross section of a watercourse; or

(c) depositing or placing an object or solid material in a watercourse or lake is to be undertaken on a watercourse or drainage line not delineated on the Figure 9.

8.6 Object or solid material on the floodplain

A permit is required for depositing or placing an object or solid material on the floodplain of a watercourse to control flooding from the watercourse or lake pursuant to Section 127(5)(f) of the Act.

108. Depositing or placing an object or solid material on the floodplain of a watercourse or near the bank or shore of a lake to control flooding from the watercourse or lake must not:

(a) increase the risk of flooding (including upstream or downstream);

(b) result in watercourse erosion;

(c) increase water tables and salinity; or

(d) cause detrimental impacts on water dependent ecosystems, for example, but not limited to, habitat destruction, alteration of flows or affecting species migration.

109. A permit is not required under this sub-section where the depositing or placing an object or solid material on the floodplain of a watercourse to control flooding from the watercourse or lake is on a watercourse not delineated on Figure 9.

8.7 Destroying vegetation

A permit is required for destroying vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse pursuant to Section 127(5)(g) of the Act.

8.7.1 Erosion / sedimentation

110. Vegetation must only be destroyed in such a way that does not cause or increase erosion or sedimentation.

8.7.2 Biodiversity

111. Vegetation may not be destroyed if it has significance as a habitat for wildlife.

8.7.3 Water quality

112. Vegetation must not be destroyed if the destruction is likely to lead to the deterioration in the quality of underground water or water in watercourses or surface water run-off.

113. A permit is not required under this sub-section where:
    (a) the destruction of vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse is undertaken no less than 40 metres from the banks of a watercourse;
    (b) the Board has provided financial or any other form of assistance pursuant to section 42 of the Act, in relation to the destruction of vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse;
    (c) the proposed vegetation to be destroyed is growing in a watercourse or lake or growing on the floodplain of a watercourse not delineated on Figure 9; or
    (d) involves either proclaimed plants or other vegetation that does not involve the physical removal of the plants.

8.8 Excavation or removal of rock, sand or soil

A permit is required for the excavation or removal of rock, sand or soil from a watercourse or the floodplain of a watercourse pursuant to Section 127(5)(h) of the Act.

114. The excavation and removal of rock, sand or soil must not adversely impact on water dependent ecosystems, for example, but not limited to, habitat destruction, alteration of flows or affecting species migration.

115. Alteration to the alignment of a watercourse may only occur where it is for the protection of existing buildings, structures and infrastructure or rehabilitation of a watercourse and the realignment does not result in any of the following:
    (a) increased erosion;
    (b) increased flooding;

(c) bed and bank instability;
(d) downstream sedimentation;
(e) loss of riparian vegetation;
(f) reduction in water quality; or
(g) alteration to the natural flow regime of a watercourse.

116. A permit is not required under this sub-section where:
(a) the excavation or removal of rock, sand or soil from a watercourse or the floodplain of a watercourse is undertaken no less than 40 metres from the banks of a watercourse;
(b) the Board has provided financial or any other form of assistance in relation to the excavation or removal of rock, sand or soil from a watercourse or the floodplain of a watercourse pursuant to section 42 of the Act;
(c) the excavation or removal of rock, sand or soil from a watercourse or the floodplain of a watercourse relates to a watercourse not delineated on Figure 9; or
(d) involves the removal of less than 2 cubic metres of material in any 5 year period.

8.8.1 Maintenance of dams

117. Excavation of material ("de-silting") from a dam in a watercourse or the floodplain of a watercourse to maintain the capacity of the dam shall require a permit, except where that excavation is only of unconsolidated material deposited since the construction of the dam or material deposited since the dam was previously desilted, and must not result in an increase in the capacity of the dam or damage to the environment.

118. Excavation of material ("de-silting") from a "turkey nest" dam is exempted from requiring a permit.

8.9 Use of imported water

For the purposes of this section, the Minister will publish, by notice in the South Australian Government Gazette:

(a) details of the relevant salinity trends for each sub-region; and
(b) a list of the relevant exchange rates by volume (based on equivalent salinity) between imported water and underground water, surface water and watercourse water applying in each of the sub-regions, together with the relevant salinities of each source

and from time to time as practicable, will revoke each notice and publish a new notice with the updated details referred to in (a) and (b).

The calculation of salinity trends from time to time will be measured against baseline data which takes into account the use of imported water prior to 29 September 2004, and will be based on measurable changes in salinity from time to time that result from both natural and artificial processes, influences or actions (including but not limited to changes in the total volume of imported water authorised for use in a sub-region by either permit or licence to take from a resource).

A permit is required to use imported water in the course of carrying on a business pursuant to Section 127(5)(i) of the Act if:

(a) the water is used at a rate that exceeds 0.5 ML/water use year, where the rate is based on the total volume of imported water used on all land parcels owned or leased by the applicant within a sub-region, irrespective of whether the land parcels are contiguous or not; and

(b) the imported water is applied to land for irrigation purposes, either directly or following use in another process (e.g. in a winery process or intensive animal production).

119. A permit may only be granted for use of imported water in sub-regions where:

(a) salinity trends indicate that existing underground water salinities are decreasing; or

(b) existing underground water salinity trends are steady or increasing, and where it can be demonstrated that:

(i) the conditions in principle 120 are met; and

(ii) the relevant authority approves the exchange of an existing water (taking) allocation(s) for a right to use imported water in accordance with section 6.7; or

(c) principles 136 or 139 apply.

120. A permit should not be granted unless the relevant authority is satisfied that the use of the imported water will not:

(a) cause, or be likely to cause, a rise in the underground water level resulting in detrimental effects to structures or ecosystems; or

(b) result, or be likely to result, in adverse effects on the natural flow or quality of another water resource; or

(c) result, or be likely to result, in adverse effects to the productive capacity of the land including but not limited to, increases in land salinisation, waterlogging, or perched water tables; or

(d) adversely affect water dependant ecosystems.

121. The total volume of water from all sources that the permit applicant would be authorised under the Act to take and/or apply to the relevant land (including the imported water if the permit were granted) should not exceed 1 megalitre per hectare of the relevant land per annum (where the relevant land is the aggregate of all contiguous land parcels owned or leased by the applicant), unless the relevant authority is satisfied that the application of more than 1 megalitre of water per hectare in any specified area of the land will not result in any of the adverse effects referred to in principle 120.

122. In the case of an application for a permit to use imported water for a new irrigation development or a proposed enlargement of an existing irrigation development where the relevant crop has not yet been planted, evidence in the form of an Irrigation Salinity Management Plan or other relevant information provided by the permit applicant must either:

(a) demonstrate that the following conditions are met in respect of the relevant land:

(i) the land is not over a water table less than 2 metres below the soil surface; and

(ii) electrical conductivity (EC) of the soil water extract is not greater than 2 deci-Siemens per metre at any depth within the top 2 metres of soil; and

(iii) exchangeable sodium is no greater than 6% of the sum of Calcium plus Magnesium plus Potassium plus Sodium, at any soil depth greater than one metre, as measured in cmol(+)/kg;

or

(b) demonstrate to the satisfaction of the relevant authority that the use of imported water on the subject land will not cause significant adverse impacts on the land.

123. Imported water containing residual chlorine or other treatment chemicals must not be discharged into surface water or watercourses or on land adjacent to surface water or watercourses.

124. Imported water must not be transported in a watercourse or along a drainage path.

125. If imported water is to be stored, the storage facilities must be constructed and operated in a manner that prevents any detrimental impact on the quality of underground water or the health of water dependent ecosystems.

126. If imported water is to be stored in a dam, the dam must have no natural catchment (in order to prevent imported water entering the environment) unless either the proponent can demonstrate to the satisfaction of the relevant authority that the dam is constructed in such a way as to prevent any unauthorised discharge of imported water to the environment, or the applicant is a pre existing user as defined in principle 128 and was storing imported water in a surface water dam prior to 22 December 2000.

127. The volume of imported water used must be separately metered.

128. If an applicant for a permit for the use of imported water as required by this section demonstrates to the satisfaction of the relevant authority that imported water was used on the relevant land prior to 29 September 2004 then principles 119, 120 and 121 will not apply.

129. A permit for use of imported water must specify a maximum volume for use per water use year irrespective of the method of use, the type of crops irrigated, frequency of irrigation or any other factor.

130. A permit for the use of imported water should be granted for a fixed period and will expire on the date specified on the permit.

131. Where a permit for the use of imported water was granted through the exchange of a water allocation(s) in accordance with section 6.7 the holder of the permit may reverse the imported water exchange by:

(a) making an application in accordance with principle 47 to convert the relevant exchange allocation from a water (holding) allocation to a water (taking) allocation; and

(b) providing the Minister with written consent to vary the expiry date of the permit if the application made under principle 47 is granted, with effect that the permit will expire on the same date on which the application is granted.

132. Where a permit has been granted to use imported water as a result of exchanging a water allocation or allocations in accordance with section 6.7, up to 25% of the permitted volume of imported water not taken in a given water-use year may be taken and used at any time over the subsequent three water-use years, provided the total amount of imported water used in any one year does not exceed 125% of the volume authorised for use in the year that the water is used.

133. If the volume of imported water that reasonably can be estimated as available for authorised use by permit in a sub-region is less than the total volume for which permits are sought, authorisations may be issued if:

(a) a method of authorising the use of imported water that is fair and reasonable is agreed to by all of the applicants and approved by the Minister, or

(b) a method developed by the Minister if affected applicants are unable to provide an agreed method of authorising imported water use in a sub-region or if the Minister is not satisfied with the method put forward by the affected applicants.

The approved method shall be set out in a notice published in the South Australian Government Gazette.

134. Applications for permits for the use of imported water must be made, and will be assessed, on a sub-region basis. Separate permit applications are required for the use of imported water on land located within different sub-regions, including where the same landholding straddles one or more sub-region boundaries.

135. Where the land in respect of which a permit to apply imported water has been granted is sold or leased, the permit will continue to operate for the benefit of the new owner or lessee, and may be re-issued to the new owner or occupier of that land upon application.

136. The holder of an imported water permit who wishes to continue using imported water after the expiry date may apply for a new permit within 3 months after the expiry date. If an application has not been received within three months after the expiry date the volume of imported water authorised for use by the permit may be made available for provision to another user in accordance with the principle in sections 7.5 and 8.9 of this plan.

137. The holder of a permit who wishes to reduce the volume of imported water they are authorised by the permit to use may apply (on the prescribed form) to reduce the volume endorsed on the permit.

138. Any volume of imported water no longer required by a permit holder in accordance with principle 137 and volumes returned in accordance with principle 131 shall be available for provision to another user in accordance with the principles in section 8.9 of this plan.

139. The salinity trends in underground water in respect of each of the sub-regions will be reassessed by the Minister at the time this plan is reviewed in accordance with the Act (within five years of the date of adoption of this plan by the Minister).

8.10 Wells

A permit is required for the drilling, plugging, backfilling or sealing of a well and the repairing, replacing or altering of the casing, lining or screen of a well pursuant to Section 127(3)(a) & (b) of the Act.

8.10.1 Location of drilling of a well

140. Drilling of a well for domestic use and/or for watering stock other than intensively farmed stock shall only occur if the location of that well is:

(a) at least 200 metres from the nearest existing well that has supplied water for irrigation, stock, domestic or commercial use in the last 10 years; or 100 metres from the nearest existing well that has supplied water for irrigation, stock, domestic or commercial use in the last 10 years if the proponent's property is too small to enable a minimum distance of 200 metres between wells and the well is purely for domestic use; and

(b) not within a zone of influence of a permanent pool or permanent flowing stream (see Figure 7), unless the proponent's property is fully covered by such a zone of influence; and

(c) at least 500 metres from a pipeline supplying reticulated water under the Waterworks Act 1932 if the land between the proposed well and the pipeline is owned by the proponent or the proponent has legal access to this land.

141. A well must not be constructed for the purposes of extracting an underground water allocation where it will cause the density of water allocated at any point to become greater than 0.2 ML/ha.

142. A well must only be constructed for the purposes of extracting an underground water allocation where the resource protection zone of the allocation from the well, calculated by principles 21.3 and 25, does not intersect with or fall within:

(a) the boundary of an underground water zone of influence around a permanent pool or a permanent flowing stream, as indicated on Figure 7; or

(b) the boundary of an underground water exclusion zone around the towns or settlements of Mintaro, Watervale, Penwortham, Sevenhill, Armagh or Leasingham as indicated in Appendix 1.

143. A well from which it is intended to extract a water (taking) allocation must only be constructed at a location at least 200 metres from an existing operational well that has supplied water for irrigation, stock, domestic or commercial use in the last 10 years.

144. A well constructed for the purposes of resiting of the point of taking of underground water under principles 28 – 29 shall be exempt from the requirements of principles 141, 142 and 143.

8.10.2 Well construction

145. The equipment, materials and method used in the drilling, plugging, backfilling or sealing of a well must have no adverse impact on the quality of the underground water resource.

146. Wells must only be drilled in such a manner that aquifers are protected during construction of the well to avoid contamination of the underground water resource.

147. Wells for the purpose of aquifer recharge operations must be constructed so that the headworks allow both recharge and discharge operations to be metered without interference.

148. The headworks of a well from which a licensed allocation is to be taken must be constructed so that the extraction of water from the well can be metered without interference.

8.10.3 Well repair

149. Deepening, plugging, backfilling or sealing a well or repairing, replacing or altering the casing, lining or screen of a well must only occur where:
    (a) the equipment, materials and method used in the drilling, plugging, backfilling or sealing of a well do not adversely affect the quality of the underground water resource; and
    (b) the aquifers are protected during the repair, replacement or alteration of the casing, lining or screen of a well to avoid contamination of the underground water resource.

8.11 Draining or discharging water into a well

A permit is required for the draining or discharging of water directly or indirectly into a well ("artificial recharge") pursuant to Section 127(3)(c) of the Act. Additional authorisations may be required under the Environment Protection Act 1993.

150. Water that is drained or discharged into a well must comply with the Environmental Protection Act 1993 and any associated policy.

151. A permit to drain or discharge water into a well will not be issued unless a risk assessment is undertaken to the satisfaction of the Minister. This risk assessment must be consistent with the National Water Quality Management Strategy – Australian Guidelines for Water Recycling: Managing Health & Environmental Risks, Phase 1 2006 and other related documents current at the time, and include:

(a) an investigation into the suitability of the draining or discharging site, including but not limited to tests for transmissivity, effective porosity and storage coefficient, maximum injection pressures and calculated likely impacts on the integrity of the well and confining layers, and impacts of potentiometric head changes to other underground water users.

(b) an appropriate operation or management plan demonstrating that operational procedures are in place to protect the integrity of the aquifer on an ongoing basis.

(c) a water quality assessment which identifies hazards in the source water.

(d) a report on the consequences and impacts to the native underground water resource where the water quality characteristics (salinity and chemistry composition) of the water to be discharge differs to that of the native underground water.

152. Water that is drained or discharged into a well only by means of gravity is exempt from meeting the requirements of principle 151(a).

153. Roof runoff (surface water) that is drained or discharged into a well via a closed system of capture and transport is exempt from meeting the requirements of principles 151(a), (c) and (d), provided that the system is equipped with a mechanism to divert first flush water.

154. Further to principle 151(b), continuation of draining and discharge is dependent on an annual report that addresses the impacts to the native underground water at the draining or discharge site. Roof run-off (surface water) captured in a closed system and then drained or discharged into a well is exempt from this principle.

155. For the purposes of principles 150 and 151, the relevant concentrations, levels or amounts shall be measured in sufficient representative samples of:

(a) the water to be drained or discharged; and

(b) native underground water collected from the proposed point of injection, or as near as possible to the proposed point of injection;

where “sufficient representative samples” means suitable samples, collected with equipment appropriate for the substance, material or characteristic to be measured and taken at suitable locations and times to accurately represent the quality of the relevant water.

156. For the purposes of this plan, the term “native underground water” means the underground water (as that term is defined in the Act) that exists in the relevant aquifer absent of any such water drained or discharged to that aquifer by artificial means.

157. The draining or discharging of water directly or indirectly into a well must not detrimentally affect the ability of other persons to lawfully take from that underground water, or degrade ecosystems dependent on the underground water.

158. The headworks for the draining or discharge of water shall be constructed so that extraction and draining and discharge operations can be metered without interference.

159. The headworks for the draining or discharge of water shall be constructed so that water cannot leak if the well becomes clogged.

160. For the purposes of this plan, the term “headworks” means any assembly on top of a well and located between the well casing and the water delivery system.

161. Wells constructed for the draining or discharge of water at pressures greater than gravity, must be pressure cemented along the full length of the casing. This does not exempt the need to follow the general specifications for well construction.

8.12 Using effluent in the course of carrying on a business

A permit is required to use effluent in the course of carrying on a business in the Prescribed Area at a rate that exceeds 0.5 ML per annum, pursuant to Section 127(5)(j) of the Act.

8.12.1 Impact on the receiving water resources

162. A permit for the use of effluent shall only be granted where the proposed location and manner of use of the effluent has:
    (a) no detrimental effects on the receiving water resources, including, but not limited to, changes in the natural flow, pollution or an increase in salinity; and
    (b) no adverse effects on those qualities of any receiving water that ecosystems depend on.

163. Effluent must not be discharged into any surface water or watercourses or onto land in a place from which it is reasonably likely to enter any waters.

164. Effluent must not be transported in a watercourse or along a drainage path.

165. Where effluent is stored in a wastewater storage lagoon or dam, the dam or lagoon must have no natural catchment (a “turkey nest” dam or a wastewater storage lagoon) that satisfies the requirements of the Environment Protection Policy for Water Quality (2003) and any other appropriate policy or regulation.

166. Any necessary facilities for storage of effluent must be constructed and operated in a manner that prevents any detrimental impact on the quality of the prescribed water resources or the health of water dependent ecosystems.

8.12.2 Effects of effluent use on the productive capacity of the land

167. A permit for the use of effluent must only be granted where the proposed location and manner of use of the water has no detrimental effect on the productive capacity of the land (where water is applied or elsewhere), including, but not limited to, creating perched water tables less than 2 metres from the surface or waterlogging.

8.12.3 Effects of effluent use on the underground water level

168. A permit for the use of effluent must only be granted where the proposed location and manner of use of the water does not cause a rise in the underground water level sufficient to detrimentally affect structures or ecosystems.

8.13 Summary of water affecting activities requiring permits

NRM Act reference and water affecting activities	Exempt or excluded activities (in addition to those set out in Section 129 of the Act)	Relevant authority
127(3)(a) - Drilling plugging backfilling or sealing a well	No exempt or excluded activities	Minister
127(3)(b) - Repairing replacing or altering the casing, lining screening of a well	No exempt or excluded activities	Minister
127(3)(c) - Draining or discharging water directly or indirectly into a well	No exempt or excluded activities	Minister
127(3)(d) - The erection, construction, modification, enlargement or removal of a dam, wall or other structure that will collect or divert, or collects or diverts— (i) water flowing in a prescribed watercourse; or (ii)surface water flowing over land in a surface water prescribed area	• Desilting of dams providing it involves the removal of unconsolidated material deposited since construction of the dam or material deposited since the dam was previously desilted. • Desilting turkey nest dams. • Contour banks, where a certificate has been issued in respect to the NRM Board endorsed Best Operating Practices.	Minister / Board[1]
127(5) (b) - The erection, construction or placement of any building or structure in a watercourse or lake or on the floodplain of a watercourse	• Activity that is proposed to be undertaken at a distance of 40 metres or more from the banks of the nearest watercourse and that does not involve any structure associated with the extraction of water. • Activity where the NRM Board has provided financial or other assistance pursuant to section 42 of the Act. • Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9. • Activity undertaken where a certificate has been issued in respect to the NRM Board endorsed Best Operating Practices.	Board

[1] Minister until such time as the Regional NRM Plan is adopted and the Minister provides the appropriate certificate to confirm this, after which it is the Board

NRM Act reference and water affecting activities	Exempt or excluded activities (in addition to those set out in Section 129 of the Act)	Relevant authority
127(5) (c) - Draining or discharging water directly or indirectly into a watercourse or lake	• Activity where the NRM Board has provided financial or other assistance pursuant to section 42 of the Act. • Activity that involves draining or discharging water of better quality than the receiving waters that does not exceed a volume of 0.5ML • Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9. • Activity undertaken where a certificate has been issued in respect to the NRM Board endorsed Best Operating Practices.	Board
127(5) (d) - Depositing or placing an object or solid material in a watercourse or lake	• Activity where the NRM Board has provided financial or other assistance pursuant to section 42 of the Act. • Activity that involves a non polluting object or solid material that occupies less than 5% of the cross section of a watercourse. • Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9.	Board
127(5) (f) - Depositing or placing an object or solid material on the floodplain of a watercourse or near the bank or shore of a lake to control flooding from the watercourse or lake	• Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9	Board
127(5) (g) - Destroying vegetation growing in a watercourse or lake or growing on the floodplain of a watercourse;	• Activity that is proposed to be undertaken at a distance of 40 metres or more from the banks of the nearest watercourse. • Activity where the NRM Board has provided financial or other assistance pursuant to section 42 of the Act. • Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9. • Activity that involves either proclaimed plants or other vegetation that does not involve the physical removal of the plants.	Board
127(5) (h) - Excavating or removing rock, sand or soil from— (i) a watercourse or lake or the floodplain of a watercourse; or (ii) an area near to the banks of a lake so as to damage, or create the likelihood of damage to, the banks of the	• Activity that is proposed to be undertaken a distance of 40 metres or more from the banks of the nearest watercourse. • Desilting of dams in a watercourse or in the floodplain of a watercourse providing it involves the removal of unconsolidated	Board

NRM Act reference and water affecting activities	Exempt or excluded activities (in addition to those set out in Section 129 of the Act)	Relevant authority
lake.	material deposited since construction of the dam or material deposited since the dam was previously desilted. • Desilting turkey nest dams. • Activity where the NRM Board has provided financial or other assistance pursuant to section 42 of the Act. • Activity that is proposed to be undertaken on any watercourse or drainage line not delineated on Figure 9. • Activity that involves the removal of less than 2 cubic metres of material in any 5 year period.	
127(5) (i) - Using water in the course of carrying on a business in the Prescribed Area at a volume that exceeds 0.5 megalitre of water that has been brought into the region by means of a pipe or channel	No exempt or excluded activities	Minister
127(5)(j) - Using effluent in the course of carrying on a business in the Prescribed Area at a rate that exceeds 0.5ML per annum	No exempt or excluded activities	Minister

9 Taking and use of other water resources

The management of the water resources of the Prescribed Area will be influenced in the future by the use of imported water, as land adjacent to the pipeline may be able to access imported water, even if the development of the prescribed surface, watercourse and underground water resources have reached the limits of allocation.

The management of the importation and use of water from other resources shall be consistent with the principles of this Plan and in particular with the following sections of this plan:

- Section 6.7: Exchange of water for use of imported water;
- Section 7.5: Variation of an authorisation to use imported water; and
- Section 8.9: Use of imported water.

10 Monitoring

Section 76(4)d of the Act requires the Plan to assess the capacity of the resource to meet demands for water on a continuing basis and provide for regular monitoring of the capacity of the resource to meet those demands.

A comprehensive monitoring program that considers the ecological, hydrological and hydrogeological performance of the Prescribed Area is recommended to compare desired management outcomes with actual outcomes and to evaluate the effectiveness and efficiency of water provisions. A detailed program to monitor the parameters listed below will be formulated and implemented through the investigations program detailed in the Northern and Yorke Regional Natural Resource Management Plan.

10.1 Current monitoring

The Department of Water, Land and Biodiversity Conservation maintains a monitoring network in the Clare Valley, which is continually being reviewed. The nature of the surface water resources and the watercourses in the Clare Valley are complex and relatively little is known about the characteristics of these water resources and the water dependent ecosystems. Information collected from the Mid North Rivers Management Planning Project, the Waterwatch program and other relevant water projects will provide valuable data to improve understanding of the nature and complexity of the Broughton and Wakefield River systems.

While the current monitoring program may be adequate for the scale of state-wide reporting, building on these protocols could also be used to help characterise ecosystem condition at reach to catchment scale. This would require an expanded program, employing more intensive spatial and temporal distribution of monitoring effort to understand underlying patterns of natural variation. Greater understanding of the nature and requirements of the ecosystems dependent on the resource could follow from the expansion of the program to various habitat types, such as low flow areas, including pools, to contrast with high stream gradients and turbulence.

Long-term studies of macroinvertebrate populations including their migration patterns and reproductive biology should be included in this monitoring.

10.1.1 Surface water

Surface water quality

The Environment Protection Authority carries out monthly “grab sampling” as part of its ambient and macroinvertebrate monitoring program in the Hill River catchment. From monthly samples, there is monitoring of levels of nitrogen oxides (NOx), total kjeldahl nitrogen (TKN), soluble phosphorus (Psol), total phosphorus (Ptot), Dissolved Organic Carbon (DOC), Turbidity, Dissolved Oxygen (DO), Salinity (EC), pH and temperature with biannual sampling for macroinvertebrates and alkalinity.

Salinity is continuously monitored by the Department of Water, Land and Biodiversity Conservation on Eyre Creek at Auburn and Watervale and on the Skillogalee Creek.

Surface water flow monitoring

Surface water flows of seven catchments that are partially or entirely within the Prescribed Area are currently monitored. The locations of the flow recording sites include:

- Hutt River near Spalding;
- Hill River near Andrews;
- Eyre Creek at Watervale;
- Eyre Creek at Auburn;
- Skillogalee Creek at Goodonga;
- Wakefield River near Rhynie; and
- Broughton River near Spalding.

The three flow recording sites located on the Hutt River near Spalding, Hill River near Andrews and Wakefield River near Rhynie measure, between them, 85% of the Prescribed Area. The other four flow recording sites are located within the Prescribed Area as sub-catchments within the headwaters of the Wakefield and Hutt River catchments.

10.1.2 Underground water

A network of observation wells is used for monitoring the underground water levels in the Prescribed Area. Further investigations are required to better understand the underground water systems including the relationship between rainfall, aquifer discharge and baseflow levels and to determine the impact of underground water extraction on surface water flows in the Prescribed Area.

10.1.3 Rainfall

The Bureau of Meteorology currently records rainfall at the following three rainfall stations within the Clare region: Clare (Calcannia): 21075; Clare (Hill River): 21025; and Watervale: 21054.

10.2 Monitoring the status and capacity of the water resource

The location and data to be recorded in the monitoring program for the prescribed water resources and the water resources upstream and downstream of the Prescribed Area are outlined in Tables 12 - 14.

A report will be prepared annually that summarises the use of the water resources in the previous year and the status of the underground water, watercourse and surface water resources and the capacity of the resources to meet the predicted demands on these resources. The Board will monitor the health of riparian areas downstream of the Prescribed Area to assess the impact of water extraction and other impacts on these areas and the results of this monitoring program will be included in the report.

Table 12. Underground water monitoring

Monitoring				Evaluation	
What	**Where**	**When**	**Who**	**When**	**Who**
Underground water levels	Monitoring network locations in the Prescribed Area	Biannually	DWLBC	Biennially	NYNRM Board
Water quality (mainly salinity)	Monitoring network locations in the Prescribed Area	Biannually	DWLBC	Biennially	NYNRM Board

Table 13. Monitoring of surface water quality, water flows and water dependent ecosystems

Monitoring				Evaluation	
What	**Where**	**When**	**Who**	**When**	**Who**
Water levels, health and diversity of aquatic vegetation and fauna, turbidity, salinity, pH, nutrients and pollutants	Strategic permanent pools	Monthly between January and the first winter rains	NYNRM Board	Biennially	NYNRM Board
Level, duration, frequency, seasonality, rates of rise and fall of flow events	Key locations in watercourses in each sub-region including 7 existing flow recording stations	Continually	DWLBC	Biennially	NYNRM Board
Turbidity, salinity, pH, nutrients and pollutants	Key locations in watercourses	During flow events	NYNRM Board	Biennially	NYNRM Board
Turbidity, salinity, pH, nutrients and pollutants	Key locations in watercourses	As required to determine background	EPA / AUSRIVAS	Biennially	NYNRM Board
Location, quantity, diversity and health of riparian vegetation	Key sections along watercourses	Annually	NYNRM Board	Biennially	NYNRM Board
Location, quantity, diversity, migration patterns and health	Key locations along	During winter and	NYNRM Board	Biennially	NYNRM Board

of fish, amphibians, macroinvertebrates and other waterdependent fauna and ecosystems.	watercourses	flow events			
Location, quantity, diversity and health of floodplain vegetation and downstream ecosystems such as lignum swamps and riverine shrublands	Key sections along watercourses	Annually	NYNRM Board / DEH	Biennially	NYNRM Board
Capacity of dams, including stock and domestic dams	Survey throughout the Prescribed Area	Capacity of dams is a once off assessment to be kept up to date as permits are granted.	DWLBC	Following assessment	NYNRM Board

Table 14. Monitoring of other water sources

Monitoring				Evaluation	
What	**Where**	**When**	**Who**	**When**	**Who**
Quality of water to be drained or discharged into the underground water	In storage facilities	As specified on permit	Permit Holder	Annually	DWLBC

10.3 Recording annual water use at property level

10.3.1 Users of imported water

All persons authorised to use imported water under a permit or water licence must submit an Irrigation Annual Report to the Minister on or before 31 July each year. The Irrigation Annual Report must be submitted in a manner and form prescribed by the Minister. The data provided by users of imported water will be collated and a summary will be provided to each imported water user before 31 December each year.

10.3.2 Users of water resources other than imported water

Following consultation with the licensees, the Board may decide to instruct that an annual water use report be prepared by each licensee. If instructed, an annual water use record is to be prepared by each licensee and submitted to the Board.

If an annual water use record is required, the Board will consolidate the responses and provide a report to the licensees of the performance and the status of the resource and the rate of use.

11 Consistency with Other Plans and Legislation

In preparing this Plan, the Board has had regard to:

(a) section 7 of the Act;

(b) the Initial Northern and Yorke Natural Resources Management Plan;

(c) South Australia's Strategic Plan 2007;

(d) the Intergovernmental Agreement on a National Water Initiative;

(e) the State Natural Resources Management Plan 2006; and

(f) the following plans and policies as listed in Section 75(5) of the Act:

  (i) relevant management plans under the *Coast Protection Act 1972*;

  (ii) relevant Development Plans under the *Development Act 1993* (subject to any proposal to amend such a plan);

  (iii) relevant environment protection policies under the *Environment Protection Act 1993*;

  (iv) relevant plans of management under the *National Parks and Wildlife Act 1972*; and

  (v) the principles of clearance of native vegetation under the *Native Vegetation Act 1991* and guidelines relating to the management of native vegetation adopted by the Native Vegetation Council under that Act.

12 Definitions and Abbreviations

12.1 Definitions

Terms used in this Plan that are defined in the Act shall have the definitions set out in that Act. In addition the following terms shall have the definitions set out below.

"**aquifer storage and recovery**" means the process of drainage or discharge of water directly or indirectly to a well for the purpose of recharging the aquifer or of recharging the aquifer for subsequent extraction.

"**aquifer test** " means a test conducted on a well at a constant pump rate in accordance with best industry standards and in particular with Australian Standard 2368/99 to determine the characteristics of the aquifer at that well.

"**catchment**" of a particular point means all of the land from which runoff would flow to that point.

"**contiguous land**" means land that:

(a) abuts on the other land at any point; or

(b) is separated from other land only by:-

i. a road, street, lane, footway, court, alley, railway, watercourse or thoroughfare; or

ii. a reserve or other similar open space.

"**dam**" means dam, wall or other structure that collects or diverts water.

"**date of adoption**" means the date on which the Minister adopts this water allocation plan.

"**detrimental impact or effect**" means an impact or effect that reduces the ability of any other user including the environment to continue operating as they were before the well is operated.

"**downstream location**" of a particular point means a location that may be reached by following the direction of the natural flow of water from that point without at any stage moving in a direction that is against the natural flow of water.

"existing operational well" means a well that is completely and lawfully constructed and used for the taking of water (whether intermittently, irregularly, frequently or continuously).

"**flood pumping**" means pumping from a watercourse during periods of flow above the threshold flood flow rate.

"**flood-pumping dam**" means an off-stream dam used to store water that is diverted from a watercourse by means of flood-pumping.

"imported water" means water brought into the Area by means of a pipe or other channel from a water resource outside the Area.

"**Irrigation Salinity Management Plan**" means a plan that sets out the management actions and a monitoring regime intended to maintain or reduce the level of salinity impacts.

“**licensed dam**” means a dam from which or by which water is lawfully taken in accordance with a licence under the Act.

“**licensed well**” means a well from which water is lawfully taken in accordance with a licence under the Act.

“native underground water” means the underground water (as that term is defined in the Act) that exists in the relevant aquifer absent of any such water drained or discharged to that aquifer by artificial means.

“**off-stream dam**” means a dam, wall or other structure that is not constructed across a watercourse or drainage path and is designed to hold water diverted, or pumped, from a watercourse, a drainage path, an aquifer or from another source. Off-stream dams may capture a limited volume of surface water from the catchment above the dam but may not take an amount of surface water from the catchment above the dam in excess of 5 % of its total volume.

“**on-stream dam**” means a dam, wall or other structure placed or constructed on, in or across a watercourse or drainage path for the purpose of holding and storing the flow of that watercourse or the surface water.

“operational well” is a well which is equipped for use and is used for any purpose including but not limited to stock, domestic or commercial purposes.

“**permanent pool**” and “**permanently flowing stream**” means a permanent pool or permanent flowing stream as delineated in Figure 7.

“restricted watercourses” – means a watercourse with a catchment area larger than 300 hectares and/or is delineated in bold on Figure 8.

“**roof runoff** ” means surface water that flows off an elevated structure and is collected in a closed water storage facility.

“**saved water**” means any water previously allocated that has been returned to the Minister in accordance with the Act or any of its predecessor Acts.

“**sub-region**” means a sub-region delineated in Figure 5.

“turkey nest dam” means an off-stream dam that does not capture any surface water from the catchment above the dam.

“**threshold flood flow rate**” means the flow rate of a watercourse determined by multiplying 4.0 litres/second by the number of square kilometres of catchment that contributes to the watercourse that is above the point where water is diverted from the watercourse.

“**threshold flow rate**” means the flow rate of a watercourse determined by multiplying 2.0 litres/second by the number of square kilometres of catchment that contributes to the watercourse that is above the point where water is diverted from the watercourse.

“water use year” means a period of 12 months between 1 July in any calendar year and 30 June in the following calendar year.

12.2 Abbreviations

The following Abbreviations shall have the meanings set out below.

"the Act" Natural Resources Management Act 2004

"the Area" Clare Valley Prescribed Water Resources Area

"the Board" Northern and Yorke Natural Resources Management Board

"DWLBC" Department of Water, Land and Biodiversity Conservation

"GRO" General Registry Office

"the Minister" the Minister responsible for the administration of the Natural Resources Management Act 2004

"the Prescribed Area" the Clare Valley Prescribed Water Resources Area

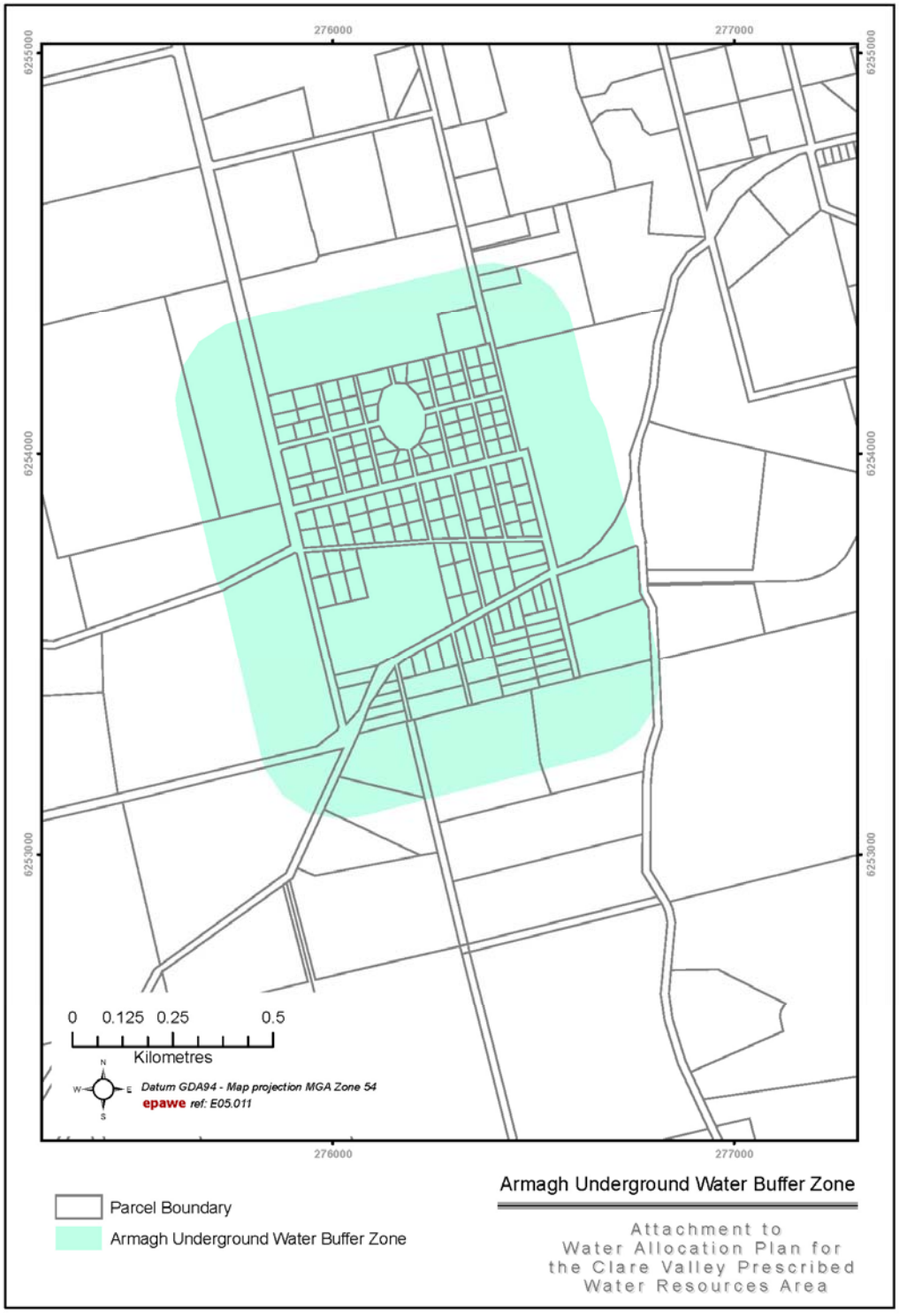
"SA Water" South Australian Water Corporation

Measurements

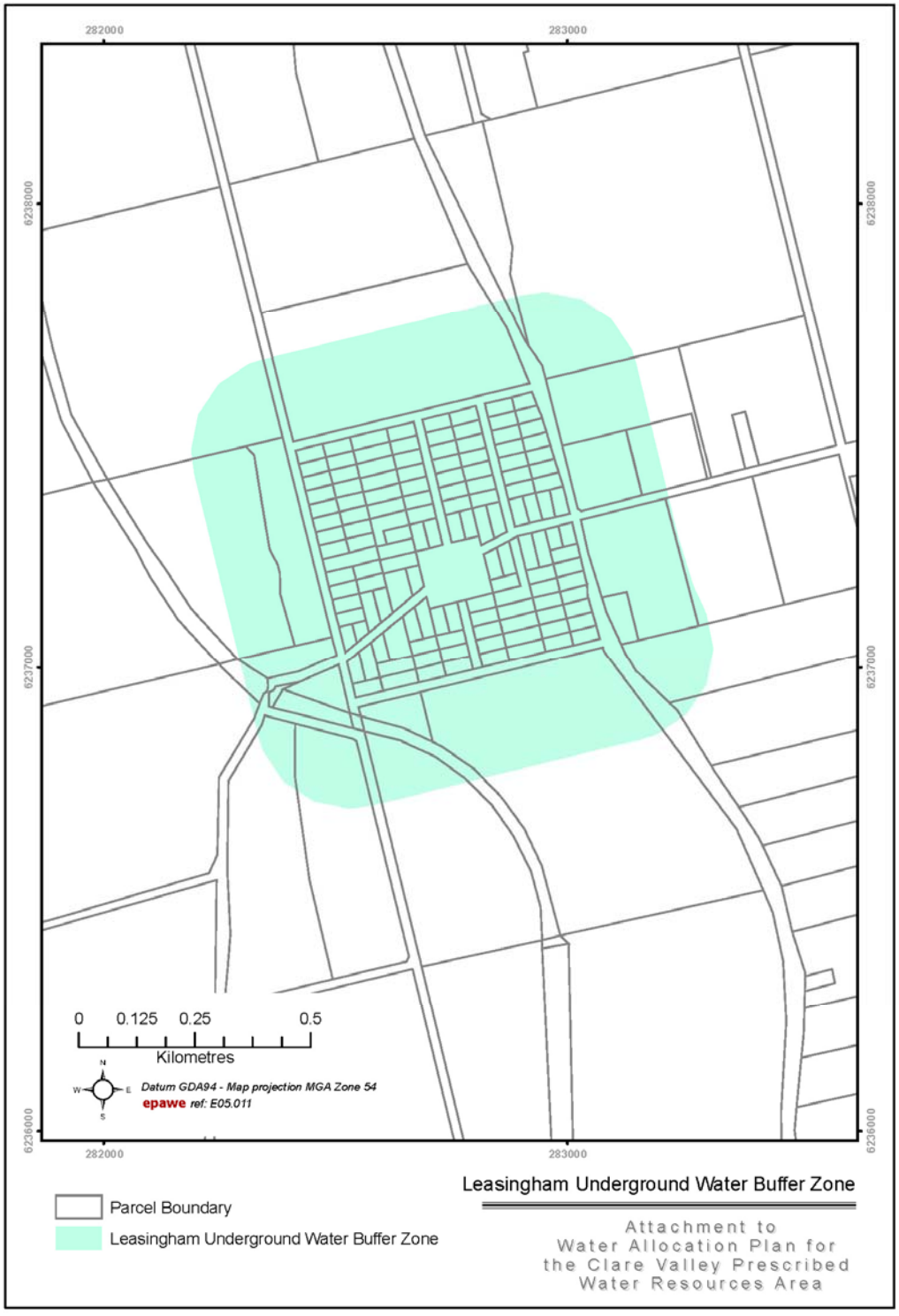
EC units	Electrical Conductivity units
GL	gigalitre(s)
ha	hectare
km	kilometre(s)
km^2	square kilometre(s)
m	metre(s)
m^2	square metre(s)
m^3	cubic metre(s)
mm	millimetre(s)
m^3/sec	cubic metre(s) per second
mg/L	milligram(s) per litre
ML	megalitre(s)
ML/ha	megalitre(s) per hectare
^oC	degree(s) Celsius

Appendix 1: Underground water exclusion zone around townships in the Prescribed Area

Armagh Underground Water Buffer Zone

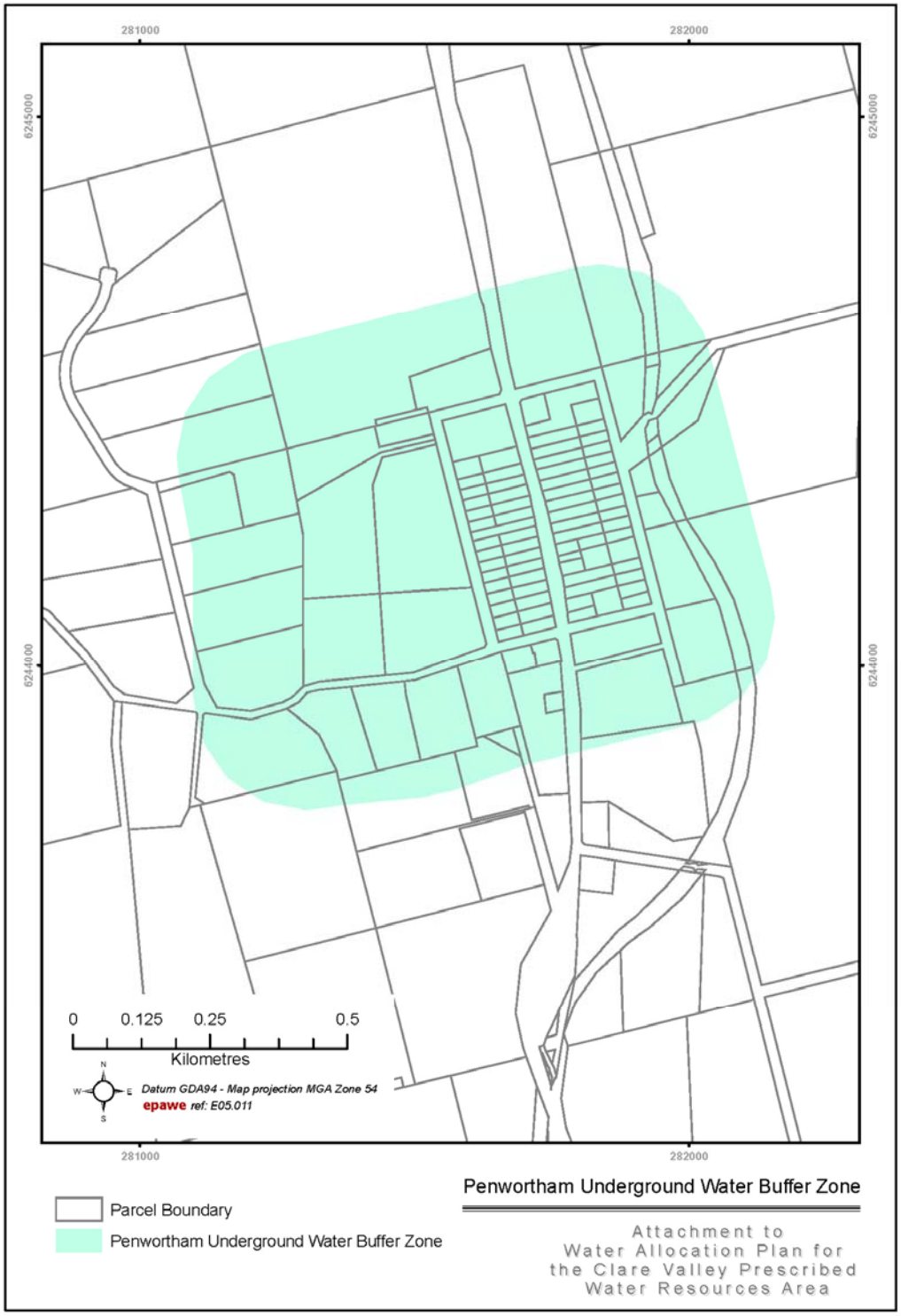


Leasingham Underground Water Buffer Zone

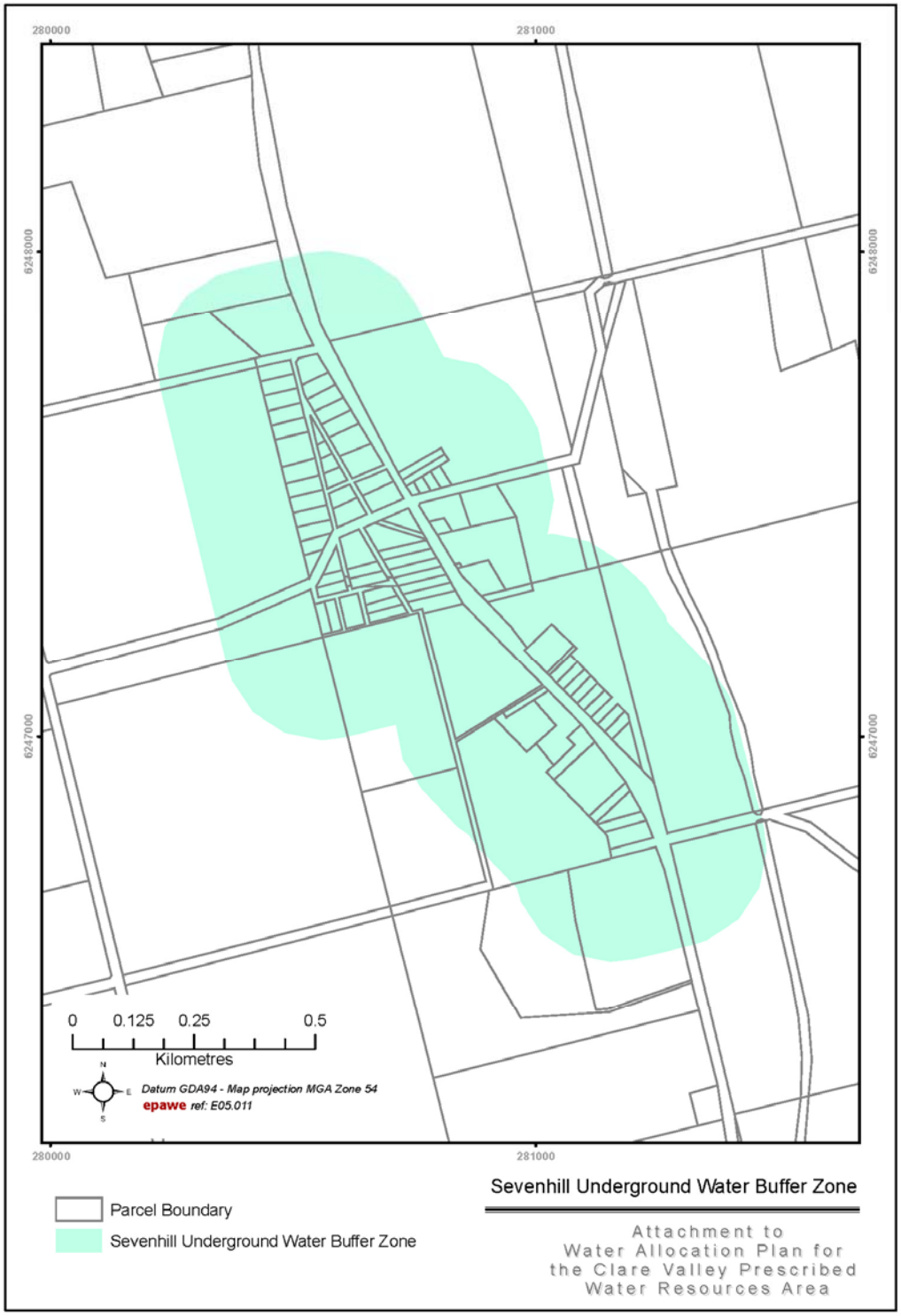


Mintaro Underground Water Buffer Zone

Penwortham Underground Water Buffer Zone



Sevenhill Underground Water Buffer Zone



Watervale Underground Water Buffer Zone